// AGRICULTURAL ENGINEERING

Published monthly by the American Society of Agricultural Engineers
at the headquarters of the Society
54 North Avenue, Mount Clemens, Michigan, U. S. A.

Subscription price to non-members of the Society, $3.00 a year, 30 cents a copy; to the members of the Society, $2.00 a year, 20 cents a copy. Postage to Canada, 50 cents additional; to foreign countries, $1.00 additional. Entered as second-class matter, November 7, 1923 at the post office at Mt. Clemens, Michigan, under Act of August 24, 1912. Acceptance for mailing at the special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized August 11, 1921.

S. H. McCRORY, President — **RAYMOND OLNEY, Secretary-Treasurer**

Vol. 5 — JANUARY, 1924 — No. 1

CONTENTS

The Object and Scope of A. S. A. E. Activities

THE American Society of Agricultural Engineers was organized in December, 1907, at the University of Wisconsin by a group of instructors in agricultural engineering from several state agricultural colleges, who felt the need of an organization for the exchange of ideas and otherwise to promote the advancement of agricultural engineering. The object of the Society, as defined by the Constitution, is "to promote the art and science of engineering as applied to agriculture, the principal means of which shall be the holding of meetings for the presentation and discussion of professional papers and social intercourse, and the general dissemination of information by the publication and distribution of its papers, discussions, etc."

The membership of the Society represents all phases of agricultural engineering, including the educational, professional, industrial, and commercial fields.

The scope of the Society's activities embraces both the technical and economic phases of the application of engineering to agriculture, and is comprehended in the following general headings:

(a) Farm Power and Operating Equipment—power, implements, machines, and related equipment.
(b) Farm Structures—buildings and other structures and related equipment.
(c) Farm Sanitation—water supply; sewage disposal; lighting, heating, and ventilating of farm buildings, and related equipment.
(d) Land Reclamation—drainage, irrigation, land clearing, etc., and related structures and equipment.
(e) Educational—teaching, extension, and research methods, etc., employed in the agricultural engineering field.

Member, Federated American Engineering Societies

AGRICULTURAL ENGINEERING

Title Registered in U. S. Patent Office

Vol. 5 JANUARY, 1924 No. 1

Testing the Efficiency of Silage Cutters*

By F. W. Duffee

Mem. A. S. A. E. Assistant Professor of Agricultural Engineering, University of Wisconsin

DURING August and September, 1923, the agricultural-engineering staff of the University of Wisconsin conducted some very careful and elaborate tests on the efficiency of silo-filling equipment. These trials will unquestionably result in bringing about a marked increase in the efficiency of silage cutters and, consequently, a saving to farmers using them. Twenty different machines were furnished by fourteen manufacturers for the tests.

The objects of the Wisconsin tests may be stated as follows:

1. To get accurate data relative to the draft of silage cutters.
2. To determine the advantages in draft of using anti-friction bearings.
3. To determine the difference in power required to elevate at different heights.
4. To determine power required for the separate operations of cutting and blowing.
5. As the tests proceeded another factor developed for determination—the relation between r. p. m., capacity, and power requirements.

*Paper presented at the seventeenth annual meeting of the American Society of Agricultural Engineers, Chicago, November, 1923.

Apparatus used in Wisconsin tests for determining power and speed required to elevate silage into a 100-foot silo

Equipment for Tests

Silos. Seven silos, all of approximately the same height, within a few hundred feet of a wagon scales, and some 100 acres of extremely uniform corn, most of which was growing on the reclaimed marsh portion of the University of Wisconsin farm.

Power. Two 500-volt, direct-current motors, one 40-horsepower and one 15-horsepower, were used. The 40-horsepower motor, complete with starting box, speed control, and connecting cable, was mounted on the chassis of a 1½-ton truck and was used for all the main testing. The 15-horsepower motor was used when the two motors were needed at the same time, as when driving the cylinder and fan of a cylinder type cutter separately to determine the power for each operation.

Recording Power. As we worked alternately between two silos, two 500-volt, watt-hour meters were secured and installed at each of the two silos, so that the change could be made quickly from one to the other by merely disconnecting the cable to the motor. The meters were adjusted and certified as being accurate to within 0.3 per cent by the standards laboratory of the University of Wisconsin. These meters had only one line wire passing through them with a potential tap from the other line. After the first two or three tests, switches were installed in these potential taps so that the meter could be stopped or started at will. Thus only the current consumed while actually cutting was recorded and no allowances were necessary for starting or idling.

A voltmeter and ammeter were used continually to observe any peculiarities that might arise; also idling loads were taken in many cases with these.

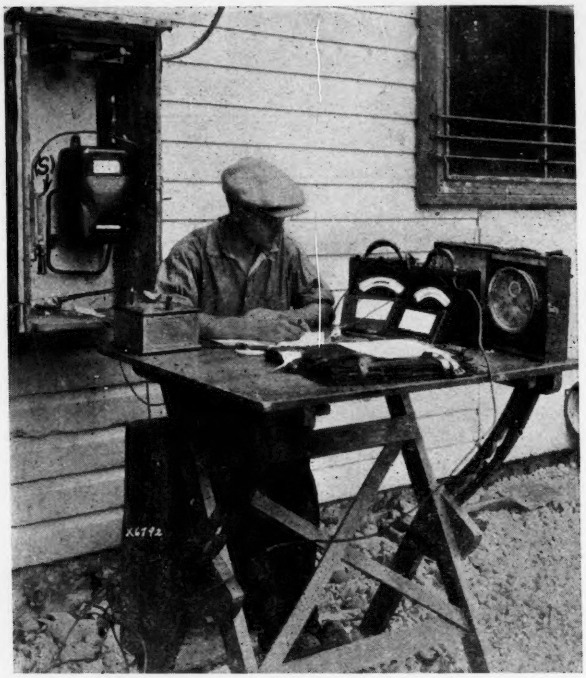
The motors were calibrated and all results were corrected for motor and belt losses. The data for horsepower and horsepower-hours per ton represented the power required at the pulley of the cutter. This point should be borne in mind when comparing the data with the results of other tests.

Time. Time was recorded first by a clock having the second hand calibrated by the decimal system, and later by a stop watch having the start and stop button separate from the rest; this was especially convenient when it was necessary to stop during a load.

Procedure in Making Tests

Half-day tests were made in practically all cases on each machine. Samples of cut corn were taken frequently during most of the tests, and a small sample of about one-half peck was taken from this large sample for determining moisture content and uniformity of cut.

In studying the power required for the separate operations of cutting and blowing on cylinder machines, the two motors were used—one driving the cylinder and the other the fan. On flywheel machines, a normal test was run with the machine operating as usual; then the knives and upper feed roll were removed and cut corn delivered from another machine of about the same capacity, with the machine under a blowing test only. Some error may have



Meter box and equipment used to record the power required to operate the silage cutters in the Wisconsin tests. The switch "B" was used for starting and stopping the meter

been introduced by the method of delivering the cut corn to the fan, as the knives striking the corn undoubtedly aid materially in getting it into motion. However, the corn was discharged into the fan with considerable force from the cutting machine.

In determining the power required at different elevations, a silo was selected having a door in the top. The pipe was elevated the required height, with a canvas return chute attached to the deflector, and the pipe guyed in place.

An early killing frost made it necessary to do most of the variable height testing, and the testing of power for the separate operations, with dry corn, but precautions were taken to complete any series of comparisons in one day if possible, so that the varying condition of the corn from day to day would be negligible.

The capacity in tons per hour represents the capacity based on continuous cutting, with no time lost between loads, which, of course, can not be secured in practical operation but seems to be the only method available for a just comparison.

Results of the Test

The tests show that there is quite a difference in the power requirements of different machines, and that a light draft machine is more a matter of perfection of design rather than of type.

Anti-Friction Bearings. No very definite conclusions can be drawn regarding the power saved by using anti-friction bearings. There is obviously so much difference in draft due to difference in design that, in order to get accurate data relative to this, it would be necessary to eliminate differences due to design by running comparative tests on the same machine under uniform conditions and with interchangeable bearings.

Effect of Height of Elevation Upon Power Required. It appears from a study of the data sheet that the power increases gradually and slowly as the height of elevation increases, other things remaining the same, such as speed and capacity.

A wide discrepancy appears between the Gehl tests at the 20-foot elevation and the 37½ and 60-foot elevations. This can be at least partically explained by the increased capacity and to the fact that the length of cut was changed from 0.44 inch for the 37½ and 60-foot elevations to 0.49 inch for the 20-foot elevation.

The increase in draft on the International 14-inch cutter at the 100-foot elevation as compared with the 30-foot elevation is 11.8 per cent, the capacity in tons per hour remaining practically the same. The increase for the Papec 16-inch cutter is only 1.5 per cent. However, there was a wide discrepancy in the capacities, the capacity at the 100-foot elevation being 13.8 tons per hour and at the 30-foot elevation 22.1 tons per hour at 670 r. p. m. This latter capacity apparently was beyond the efficient capacity of the machine. A calculation was made by cross-checking in several ways to determine what would probably be the power requirements of this machine at about 14 tons per hour, and it was found that on this basis the increase would be about the same as for the McCormick-Deering machine. The figures on other machines check very closely with this, with one exception as mentioned above, that is, the increase in power seems to be about in direct proportion to the increase in height.

The Separate Operations of Cutting and Blowing. In the study of the power required for the separate operations we find some wide discrepancies, some of which can be accounted for and others not, with the limited number of tests.

On one cylinder machine cutting frosted corn, cutting required 0.328 horsepower-hours per ton, and blowing 0.838 horsepower-hours per ton at 6.92 tons per hour and 0.819 horsepower-hours at 7.63 tons per hour. The better efficiency at the higher speed is probably accounted for by the increased capacity. The cutting operation represents 28.38 per cent of the total, and the average power for blowing 71.72 per cent of the total.

On another cylinder machine cutting green corn, the cutting operation required 0.627 horsepower-hours per ton and the blowing averaged 0.7 horsepower-hours per ton, the cutting representing 47.3 per cent and the blowing 52.7 per cent. In this case decreasing the fan speed from 1018

TABLE SHOWING THE POWER REQUIRED TO OPERATE SILAGE CUTTERS WHEN ELEVATING INTO SILOS OF DIFFERENT HEIGHTS

	Name of Cutter	Type	Size Inches Width	Length of Cut-Inches	Diameter of Blower Pipe-Inches	Height of Silo-Feet	Speed r. p. m.	Tons per Hour	Average Net Horsepower	Horsepower Hours per Ton
1	Gehl	Flywheel	16	.44	8	20	585	16.00	16.05	1.003
2	Gehl	Flywheel	16	.44	8	37½	590	12.60	17.00	1.349
3	Gehl	Flywheel	16	.44	8	60	609	13.38	18.20	1.360
4	Case*	Flywheel	14	.46	8	35	545	12.70	12.30	0.968
5	Case*	Flywheel	14	.46	8	50	555	12.83	12.60	0.982
6	McCormick-Deering	Flywheel	14	.46	8¾	30	536	8.85	10.35	1.170
7	McCormick-Deering	Flywheel	14	.46	8¾	30	655	14.76	21.20	1.436
8	McCormick-Deering	Flywheel	14	.46	8¾	100	662	15.14	24.30	1.606
9	Papec	Flywheel	16	.492	6½	30	575	20.80	26.60	1.280
10	Papec	Flywheel	16	.492	6½	30	670	22.10	32.40	1.460
11	Papec**	Flywheel	16	.492	6½	30	670	14.00		(1.32—1.36)
12	Papec	Flywheel	16	.492	6½	100	670	13.80	20.45	1.482

Conditions—Frosted corn, leaves dry

* Green corn

** No. 11 is calculated by cross checking so as to give an efficiency at 14 tons per hour more nearly comparable to the 100 foot elevation test.

TABLE SHOWING THE RELATION BETWEEN SPEED, CAPACITY, AND EFFICIENCY OR HORSEPOWER-HOURS PER TON

	Name of Cutter	Type	Size Inches Width	Condition of Corn	Speed r. p. m.	Tons per Hour	Average Net HP.	Horsepower Hours per Ton
1	Advance-Rumely	Flywheel	15	Green	747	12.50	17.70	1.420
2	Advance-Rumely	Flywheel	15	Green	694	13.03	18.20	1.396
3	Case	Flywheel	14	Green	762	11.77	16.88	1.434
4	Case	Flywheel	14	Green	662	11.66	13.90	1.192
5	Case	Flywheel	14	Green	545	12.70	12.30	0.968
6	McCormick-Deering	Flywheel	14	Green	744	16.90	24.00	1.420
7	McCormick-Deering	Flywheel	14	Green	650	16.35	21.90	1.339
8	McCormick-Deering	Flywheel	14	Green	566	17.58	20.20	1.149
9	McCormick-Deering	Flywheel	14	Green	530	17.35	17.50	1.007
10	McCormick-Deering	Flywheel	11	Green	936	8.23	12.00	1.458
11	McCormick-Deering	Flywheel	11	Green	866	8.85	11.45	1.295
12	McCormick-Deering	Flywheel	11	Green	695	7.60	7.35	0.967
13	McCormick-Deering	Flywheel	11	Green	613	7.24	6.10	0.843
14	Papec*	Flywheel	16	Dry	670	22.10	32.40	1.460
15	Papec**	Flywheel	16	Dry	575	20.80	26.60	1.280
16	Rowell	Flywheel	13	Green	887	13.37	18.40	1.375
17	Rowell***	Flywheel	13	Green	767	11.55	10.15	0.878

* Large capacity secured by having four men throwing off and three men feeding.
** High power requirement partly due to dry corn—green corn test at this speed was 1.1 HP hours per ton at 17.64 tons per hour.
*** Elevated green corn at this R. P. M. but failed to elevate wilted corn. Fan design changed slightly and retest asked for too late to be given.

to 830 r. p. m. reduced the horsepower-hours per ton from 0.727 to 0.583, of 19.8 per cent. We are not satisfied as to the accuracy of the figures for blowing at 1018 r. p. m., although the error, if any, is small.

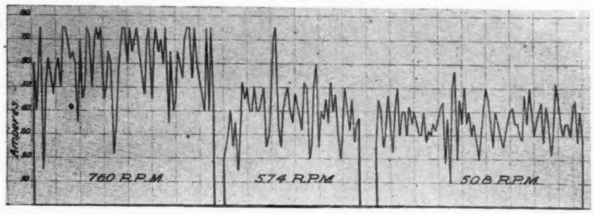
On a flywheel machine, the following figures were secured: 0.526 horsepower-hours per ton for blowing and 1.47 horsepower-hours per ton for cutting and blowing, using very dry corn, the blowing being 35.8 per cent of the total.

Why there should be this reversal between the cylinder and the flywheel types we do not know. The total power for cutting and blowing on the cylinder machines checks with a normal test run the same day on this machine.

Relation Between R. P. M. and Power Requirements. Probably the most important information revealed by the tests was the relation between speed, capacity and power requirements.

In machines of the 14-inch size and larger, the limiting factor in capacity at speeds in excess of 575 to 600 r. p. m. seems to be the men rather than the machine, this is, with two men throwing off as is the usual practice.

In several tests the capacity in tons per hour actually decreased as the machine was speeded up, resulting very probably from the psychological effect upon the workmen. In their haste and effort to keep the table filled and the machine working to capacity, they worked against themselves to a certain extent. If this relation between speed



This curve shows graphically the effect that different speeds have upon the power required to operate a 16-inch silage cutter. The ammeter did not have sufficient range to record the maximum amperage at 760 r. p. m. The line voltage averaged about 500 volts at 65 amperes. The capacity in tons per hour increased slightly at the lower speeds

TABLE SPECIFICATIONS OF SILAGE CUTTERS IN WISCONSIN TESTS

		SIZE-INCHES			CUTTER HEAD		FAN				
Name of Cutter	Type	Rated	Actual Throat Width	Actual Throat Height	Number of Knives	Bearings	Bearings	Diameter Inches	Number of Blades	Drive	Blow Pipe Diameter Inches
Advance-Rumely	Fly.	15	14 7/8	5 3/8	3	Ball	....	48	6	....	6 1/2
Algoma	Cyl.	14	12 1/2	4 3/4	3	Babbitt	Babbitt	35	4	DRC	7 3/4
Case	Fly.	14	13 1/4	7 1/2	3	Babbitt	....	41 5/8	6	....	8
Fox	Cyl.	16	13 1/2	4 1/2	4	Timken	Timken	38	6	EG	7 3/4
Gehl	Cyl.	17	14 3/16	5 1/2	3	Babbitt	Babbitt	....	6	TP	7 3/4
Gehl	Fly.	16	15	4 3/4	3	Babbitt	....	42 1/2	6	....	7 3/4
Holstein	Cyl.	16	13	3 3/4	3	Babbitt	Babbitt	39	4	Unit	7
Kalamazoo (1)	Fly.	48	15 1/8	6	2 pairs	Babbitt	....	46 1/8	4	....	8
Kalamazoo	Fly.	38	11 1/2	5	2 pairs	Babbitt	....	36	4	....	6 3/4
McCormick-Deering (2)	Fly.	14-B	14	....	3	Babbitt	....	43 3/4	6	....	8 3/4
McCormick-Deering (2)	Fly.	11-G	11	5 1/2	3	Babbitt	....	37	6	....	7
Papec	Fly.	16	14 1/2	5 1/2	3	Babbitt	....	44	6	....	6 1/2
Papec	Fly.	10	9 5/8	3 7/8	..	Babbitt	....	....	..	....	6 1/2
Plymouth	Cyl.	18	15 1/2	3 3/4	4	Babbitt	Timken	36 1/2	6	DRC	7 1/2
Ross	Fly.	12-24	14 1/4	....	4	Babbitt	....	47	6	....	7
Rowell	Cyl.	16	14 1/2	3 1/2	3	Babbitt	Babbitt	38	4	DRC	9
Rowell	Fly.	13	12 5/16	5 3/4	3	Hyatt	....	38 1/2	6	....	6 3/4
Silver	Fly.	11	10 1/2	3 1/4	4	Babbitt	....	35	8	....	6 3/4
Smalley (3)	Cyl.	18	15 1/4	4 1/4	4	Babbitt	Timken	....	4	DRC	9 3/4
Gehl	Fly.	13	13	4 3/4	3	Babbitt	....	....	6	....	7 3/4

Note:—The letters and numbers in parenthesis in the above table refer to the following notes on the test:
DRC—Diamond roller chain
EG —Enclosed gears in oil
TP —Triple pulley
Unit—Fan and cylinder on same shaft
(1) —Size refers to diameter of flywheel
(2) —Curved knife
(3) —Specially equipped for the test with Timken bearings on the fan shaft

and capacity had happened in one case only, we might have called it an accident resulting from better loading or the men working harder, but when it was repeated three or four times it tended to prove this to be a fact.

The power required decreased regularly as the speed was reduced, so that with a 14-inch machine only about two-thirds as much power was required at a speed of about 540 r. p. m. as compared to a speed of 750 r. p. m., which together with the fact that an increased capacity was secured, indicates an interesting development.

Another important observation regarding the power requirements for high versus low speeds was that at the higher speeds there was an extremely wide fluctuation in power requirements. Reference to the chart shows that at the higher speeds readings of 75 amperes were not uncommon, and the ammeter did not have sufficient capacity to record the maximum. The motor was rated to take a fraction over 64 amperes at 500 volts for 40 horsepower, so it is seen that loads in excess of 40 horsepower, and lasting for a few seconds, are frequently encountered, while at the slower speeds these peak loads are not nearly so high and the load is more uniform, a desirable condition.

The question naturally arises as to whether a machine will elevate properly under practically any and all conditions at this low speed. Reference to the data sheet shows that two machines elevated dry corn at 662 and 670 r. p. m., respectively. This indicates that if a machine is properly designed it will elevate into silos of ordinary heights at 500 to 600 r. p. m. However, these reduced speeds must not be adopted until it is absolutely certain that the machine will elevate under ordinary adverse conditions. Further, it will probably be hard to convince a great many farmers that the capacity at the slower speeds is as great as at higher speeds, as machines are ordinarily fed.

With the smaller machines the capacity of the machine seems to be the limiting factor with two men throwing off, and therefore the capacity is about in proportion to the speed. That this same thing is true of larger machines when they are fed to capacity is demonstrated by referring to one of the Papec tests where a capacity of 22.1 tons of dry corn per hour was secured at 760 r. p. m. This was done by throwing off part of the load into two piles, one on each side of the feed table as the silo was located in such a way as to make it impossible to get to the machine with two wagons. Four men threw on to the feed table and two or three were helping feed.

A test on one machine at different elevations tends to indicate that too excessive a speed will not elevate as well as a more moderate speed. This was not proved conclusively in this case, and fan design would of course alter or affect this so that no definite conclusions can be drawn.

TABLE SHOWING RESULTS OF WISCONSIN SILAGE CUTTER TESTS

NO.	Name of Cutter	Type of Cutter	Size-Inches	Height of Silo-Feet	Water percent	Uniformity of Cut	Length of cut-inch	Cutter Speed-r. p. m.	Fan Speed-r. p. m.	Tons per hour	Average net Horsepower	Horsepower Hours per ton
1	Advance-Rumely	Fly.	15	37½	72.5	V. G.	.525	747	....	12.50	17.70	1.420
2	Advance-Rumely	Fly.	15	37½	72.5	V. G.	.525	694	....	13.03	18.20	1.396
3	Algoma	Cyl.	14	35	75.7	Ex.	.416	613	805	10.76	12.60	1.170
4	Case	Fly.	14	35	72.4	V. G.	.460	762	....	11.77	16.88	1.434
5	Case	Fly.	14	35	72.4	V. G.	.460	662	....	11.66	13.90	1.192
6	Case	Fly.	14	35	72.4	V. G.	.460	545	....	12.70	12.30	0.968
7	Case	Fly.	14	50	72.4	V. G.	.460	555	....	12.83	12.60	0.982
8	Fox (4)	Cyl.	16	42	(1)	Ex.	.482	472	754	12.70	15.00	1.181
9	Gehl	Cyl.	17	35	75.0	Ex.	.520	707	569	15.00	14.15	0.943
10	Gehl	Fly.	16	37½	....	V. G.	.440	590	....	12.60	17.00	1.349
11	Gehl	Fly.	13	42	....	....	.490	587	....	12.90	13.50	1.047
12	Gehl	Fly.	16	20	(1)	V. G.	.490	585	....	16.00	16.05	1.003
13	Gehl	Fly.	16	60	(1)	V. G.	.440	609	....	13.38	18.20	1.360
14	Holstein	Cyl.	16	42	(1)	Ex.	.454	872	872	8.55	14.30	1.673
15	Kalamazoo	Fly.	48	35	73.6	G.	.487	866	....	16.20	28.60	1.760
16	Kalamazoo (5)	Fly.	38	35	73.0	V. G.	.479	938	....	10.57	14.15	1.338
17	McCormick-Deering	Fly.	14	35	74.0	Ex.	.460	744	....	16.90	24.00	1.420
18	McCormick-Deering	Fly.	14	35	74.0	Ex.	.460	650	....	16.35	21.90	1.339
19	McCormick-Deering	Fly.	14	35	74.0	Ex.	.460	566	....	17.58	20.20	1.149
20	McCormick-Deering	Fly.	14	35	74.0	Ex.	.460	530	....	17.35	17.50	1.007
21	McCormick-Deering	Fly.	14	30	(2)	....	.460	536	....	8.85	10.35	1.170
22	McCormick-Deering	Fly.	14	30	(2)	....	.460	655	....	14.76	21.20	1.436
23	McCormick-Deering	Fly.	14	100	(2)	G.	.460	662	....	15.14	24.30	1.606
24	McCormick-Deering	Fly.	11	35	74.4	V. G.	.460	936	....	8.23	12.00	1.458
25	McCormick-Deering	Fly.	11	35	74.4	V. G.	.460	866	....	8.85	11.45	1.295
26	McCormick-Deering	Fly.	11	35	74.4	V. G.	.460	695	....	7.60	7.35	0.967
27	McCormick-Deering	Fly.	11	35	74.7	V. G.	.460	613	....	7.24	6.10	0.843
28	Papec (4)	Fly.	16	42	71.0	Ex.	.492	584	....	17.64	19.40	1.100
29	Papec (9)	Fly.	16	30	(2)	G.	.492	575	....	20.80	26.60	1.280
30	Papec (9)	Fly.	16	30	(2)	G.	.492	670	....	22.10	32.40	1.460
31	Papec	Fly.	16	100	57.8	G.	.492	670	....	13.80	20.45	1.482
32	Papec	Fly.	10	30	48.6	G.	.400	773	....	6.85	9.95	1.450
33	Papec	Fly.	10	30	48.6	G.	.400	963	....	7.86	14.90	1.890
34	Papec	Fly.	10	100	48.6	G.	.400	973	....	7.42	12.10	1.630
35	Plymouth	Cyl.	18	37½	(1)	Ex.	.550	540	1020	15.97	21.20	1.328
36	Ross (7)	Fly.	12-24	35	72.5	V. G.	.406	608	....	12.58	19.20	1.525
37	Rowell	Cyl.	16	35	74.5	Ex.	.590	586	703	12.40	14.55	1.173
38	Rowell (6)	Fly.	13	35	74.5	(3)	.458	767	....	11.55	10.15	0.878
39	Rowell	Fly.	13	35	74.5	(3)	.458	887	....	13.37	18.40	1.375
40	Silver	Fly.	11	42	(1)	V. G.	.510	735	....	10.00	10.17	1.017
41	Smalley (8)	Cyl.	18	35	(1)	(3)	.562	600	772	14.60	19.15	1.310

Note:—The numbers in parenthesis in the above table refer to the following notes on the tests:

1. Green corn averaging about 74 per cent water.
2. Dry corn probably about 60 per cent water.
3. The blank reports on uniformity of cut indicate that no sample was taken; they do not indicate inferior cutting.
4. The place where this machine was set up was such as to make feeding difficult, resulting in not feeding it up to capacity, which would tend to produce a lower efficiency.
5. The size refers to the diameter of the flywheel.
6. Elevated green corn, but failed to elevate wilted corn at 767 r. p. m. Fan design changed slightly and a new test asked for; too late, however, to be given.
7. No manufacturer's representative present during the test. Appearance after test indicated knives had been set a trifle too close which would increase power requirements somewhat.
8. Especially equipped for the test with Timken bearings on the fan shaft. No sample was taken to determine the uniformity of cut, but observations at the time of the test indicated that this machine ranked the same as other cutters of this type.
9. Large capacity secured by having four men throwing bundles off the wagon and three or four men feeding from two piles.

Recent Tests of Ventilation Systems in Farm Buildings*

By M. A. R. Kelley

Mem. A. S. A. E. Agricultural Engineer, U. S. Department of Agriculture

THE question of the ventilation of farm buildings is a complex one and needs the cooperation of many workers to make rapid advancement. The chairman of A. S. A. E. Committee on Farm Building Ventilation conducted three tests during the past January and February, one in the state of Maine and two in New York. The first test was made in cooperation with the department of animal husbandry of the Maine agricultural college; the other two in cooperation with the rural engineering department at Cornell University. The tests were planned so as to study the effect of temperature, humidity and animal heat to make observations of several construction factors. The tests were made continuously for much longer periods than those of any previous tests. Readings over long periods will enable us to eliminate many of the variable factors and to study the proportional effect of others. The test in Maine was continued through approximately 200 hours and those in New York 60 to 90 hours, respectively.

Kata-Thermometer

An instrument, known as a kata-thermometer, was tried for the first time. This instrument, of but recent invention, has become of importance in the testing of ventilation of commercial buildings, but this is the first time it has been employed in studying the ventilation of farm buildings. We do not at present possess the information necessary to the full use of this instrument in testing the ventilation of farm buildings, but with the cooperation of the veterinarians and animal nutritionists we hope to secure the necessary data to enable us to interpret the readings of this instrument with relation to farm animals. It is not possuble to give here a full description of the instrument but the following brief summary will afford an idea of what may be accomplished by its use:

Animals react to their environmental conditions such as temperature, humidity and circulation of air. Their comfort is largely dependent upon their ability to produce and get rid of their body heat; in other words, their comfort is dependent upon the cooling power of the air which in turn if affected by temperature, humidity and the rate of air circulation. This instrument is a modified thermometer graduated from 95 to 100 degrees Fahrenheit. The bulb is heated to 100 degrees and allowed to cool to 95 degrees. The rate of the cooling of the instrument is measured by means of a stop watch and, by the use of a suitable factor or constant which is determined by the calibration of each instrument, the readings may be converted into millicolories per square centimeter per second, which in turn indicate the cooling power of the air. By using the wet bulb the evaporative effect may also be obtained. This instrument may be used as an anemometer and also to measure the rate of evaporation.

Theory of Correlations

Data from ventilation tests are difficult of interpretation because of the many variable factors which cannot be controlled but must be recorded as found. Consideration or analysis of these factors is more or less dependent upon theory, and while they may not have a dominant effect on the results, their combined effect is appreciable and must be taken into consideration in a careful analysis. Short tests do not enable one to watch the effect of variable factors; hence, it was planned to continue this series of tests for such a length of time that the mass of data obtained may be taken as evidence, a repetition of which might reasonably be expected under like conditions but in different localities. Briefly, this is the assumption made when the laws of correlation are applied to the interpretation of data. These laws were applied in the study of our data and some very interesting and valuable results were obtained. The analysis of our data has not as yet been completed but a general survey shows that there is a close relation between the flue velocity and a wind velocity of over three miles per hour, and very little relation when the wind velocity is less than three miles per hour. This has been suggested in a previous report and we now have sufficient evidence to prove that our contention was correct. The data also shows that the outside temperature has a stronger influence on flue velocity than does stable temperature. Other factors are compared similarly. This is but an indication of the scope of the investigation, the details of which cannot be included here.

Cooperation

The problem of properly ventilating a barn can only be regarded as solved when

1. It is ascertained with certainty what constitutes good ventilation;
2. The equipment is installed to meet these requirements;
3. The functions of the ventilating system are understood so that the system may be properly controlled.

No informed person could deny the great benefit of information which has been admittedly superficial and empirical or doubt that is has produced practical results, but it has now become necessary to so direct our inquiry as to secure fundamental facts upon which broader and more definite explanations of causes and effects and their relationship may be based. We need to know more of the causes so that we may design our system in accordance with conditions existing in various sections. A complete solution of one general problem cannot be reached until the related problems are solved.

The agricultural engineer can pursue with profit the study of the last two phases of the problem mentioned above but he must secure the cooperation of veterinarians, husbandmen, and nutritionists to aid him in solving the first problem. Mr. W. B. Clarkson, as his contribution to the work of the Committee, has secured the appointment and cooperation of the Ventilating Committee of the American Society of Animal Production, and through this cooperation it is hoped that this Committee will obtain data that will help us to solve our ventilation problem. The work which the late Dr. H. P. Armsby started, produced much fundamental information of value to the agricultural engineer, but the work should be continued and enlarged in order to supply the missing links.

In these days, when the marketing of farm products is receiving so much attention, the problem of proper storage is important and the ventilation of storage houses must be considered. The article by Mr. C. A. Whitnah, entitled "Ventilation of Potato Warehouses," published in the October, 1923 issue (Vol. IV, No. 10) of AGRICULTURAL ENGINEERING, is an important contribution to the work of this committee.

Prof. W. G. Ward has summarized the results of several tests of ventilators in order that the data may be made available to agricultural engineers.

Ventilation of Poultry Houses

The Committee has been able, through Prof. C. W.

*Part of the 1923 report of the Committee on Farm Building Ventilation presented at the 17th annual meeting of the American Society of Agricultural Engineers, Chicago, November, 1923.

Smith, to make a brief survey of the ventilation of poultry houses. The following is a brief digest of an experiment conducted by some of the students of the agricultural engineering department at the University of Nebraska, under the direction of Prof. Smith. The data obtained is too meager to warrant definite conclusions, but it is of sufficient interest and value to be recorded here. The Committee hopes that this work may be continued and a more comprehensive study of the subject made. There are many who advocate the use of the open front poultry house and others who think that poultry should be housed in warm quarters. It is evident that there are limitations to both practices, but it is an assured fact that if poultry houses are to be tightly built ventilation is necessary in order to avoid dampness. It is for the agricultural engineer to determine the limitations of both types of houses and to design houses suitable for different sections.

Three poultry houses, designated as Nos. 2, 4 and 5, of the same size (20 by 20 feet) were used. All houses had a single thickness of drop siding and three double sash. In No. 2 a muslin curtain 1 foot wide was placed above each window. This house contained 80 White Leghorn pullets (weight 290 pounds).

House No. 4 was lined with wall board (Sheetrock); storm sash and storm doors were installed. The house contained 80 Rhode Island Red pullets (weight 450 pounds). Muslin ventilators above windows were tightly sealed. From previous data it has been noticed that there is too great a fluctuation of temperature between day time and night in these houses and it was desired to determine the efficiency of tight construction. This house was arranged so as to get the extreme effects but at the sacrifice of good ventilation.

House No. 5 was equipped with a 20-inch ventilator and the muslin curtains were sealed. This house contained 125 White Leghorn pullets (weight 450 pounds). Each house had a capacity of 2,800 cubic feet.

Temperature records were taken during the entire month of February in houses Nos. 2 and 5, and for a shorter period in house No. 4. The following table summarizes the readings for six days as these were the only data upon which a comparison could be based.

The highest temperature in the houses usually occurred about four o'clock in the afternoon. The temperature proceeded to fall rapidly until early morning at which time it again rose, completing the cycle at late afternoon. The temperature goes down very rapidly when the birds go to roost in the evening and begins to rise again shortly before the birds leave the roost in the morning. It would seem that the birds would be better able to stand low temperatures while active than while inactive on the roost. It is possible to temper the extreme range of conditions as will be seen by the results. Prof. W. A. Lippincott asserts that the ideal condition for poultry would be that which approximates spring temperatures the year around.

Summary of Ventilation Test Data on Poultry Houses

House	Average temperature	Degrees temperature spread	Relative humidity per cent	Parts carbon dioxide in 10,000 at 32 degrees F same day
Outside	23.0	18.0	60.6	3.1
No. 2	30.0	17.0	75.6	20.8
No. 4	36.8	10.6	77.3	70.4
No. 5	30.5	17.7	75.3	11.4

Carbon dioxide tests were made of samples of air taken in the poultry houses before they were opened in the morning. The analyses of air shown in the table are the results for one day only and hence do not represent evidence sufficient for a comparison of the true air conditions in the respective houses. It is of interest to note that, although there is no significant difference in either the temperature or relative humidity between houses Nos. 2 and 5, there is less carbon dioxide in the latter. The house with muslin ventilators above the windows, namely No. 2, was next in order with regard to carbon dioxide content, ranging between 19 and 21 parts in 10,000 when the muslin was uncovered and 24 to 26 parts when the muslin was covered with heavy building paper. In this house the windows were always open at the top, and consequently the muslin cannot be given entire credit for keeping the air as good as it was. In fact, the muslin seemed to exert but little influence. It was possible to check this on only one night; hence too much emphasis should not be placed on the comparison of results. However, the data indicates what results might be obtained if a more comprehensive study were made. It must be remembered that the purity or freshness of the air is but one of the factors affecting the comfort of the birds.

Why A. S. A. E. Is Essential

THE importance of a central clearing house or point of contact to which all agricultural engineers can turn for information and guidance is obvious. That is why an organization such as the American Society of Agricultural engineers is essential to the general development of the field of agricultural engineering, and to the advancement of individuals in that field.

Such an organization obviously has numerous functions, some of which are of interest only to individual engineers, while others are of interest and are more or less beneficial to all agricultural engineers. But the most prominent and important collective function of the American Society of Agricultural Engineers is undoubtedly its activity in promoting development in the field of agricultural engineering for the benefit of all its members. As a result of this activity, the whole category of agricultural engineers, including teachers, extension specialists, research engineers, consulting engineers, and designers and manufacturers of farm equipment, canstantly look to the Society for a certain amount of information and guidance to keep them up to date and abreast of the development of the profession.

Now, how does the American Society of Agricultural Engineers go about it to promote and actually bring about development in the field of agricultural engineering? It is a more or less complex organization of engineers of different types whose training and experiece may very quite widely. However, the matter simplifies itself somewhat when it is realized that the majority of these engineers are connected with state and federal agricultural educational and research institutions or with private manufacturers of farm equipment. Some few are private consulting engineers and the number of these is increasing.

It is realized that neither the field of agricultural engineering nor any other field can undergo a process of development without a firm foundation upon which to base procedure. The matter is therefore much further simplified when the ultimate aim or objective of these engineers is considered. That objective in its last analysis is the formulation of a distinctly agricultural-engineering science to serve as a foundation for the profession of agricultural engineering.

A Review of the Important Advances in Irrigation since 1900

Editor's Note: In submitting the 1923 report of the Committee on Irrigation, the chairman, Dr. Samuel Fortier, makes this statement: "The full report of the Committee has been based upon individual reports received from the many members of the Committee, as well as from Judge H. H. Brooke, A. E. Chandler, Geo. S. Knapp, and several members of the Division of Agricultural Engineering of the U. S. Department of Agriculture. These individual reports have contained a vast amount of interesting material, which has proved invaluable in the preparation of the general report of the Committee." The report is divided into eight sections, the first four of which follows:

The Use of Water in Irrigation

IN spite of the natural conservatism of the farming class as such, the past twenty-three years have brought marked improvement in irrigation practice in western America, especially in those sections that have felt the pinch of water shortage due to rapidly increasing development. These improvements have also been especially noticeable where the higher priced products are being grown, and where irrigated areas have been subdivided into smaller holdings desired in semi-suburban settlement.

An increase in the duty of water in irrigation is one of the most obvious changes for the better in the past twenty years; yet because exactly duplicate measurements have not been made at the two ends of this period, specific comparative figures can not be cited in proof. But reading through Government irrigation reports published about 1900 we find a gross duty under entire canal systems of 5 acre-feet per acre per annum not unusual, while every engineer at all familiar with irrigation knows that such large figures are extremely rare for this day. A recent report of the irrigation division of the U. S. Bureau of Public Roads dealing with irrigation in northern Colorado shows, for instance, a stream duty on Cache la Poudre River, with over 200,000 acres irrigated, of only 1.67 acre-feet per acre. Again, the gross use under Turlock Canal, California, in 1904, as measured by the Department of Agriculture, was 8.34 acre-feet per acre, a figure that in the course of development has since been reduced to around 3 acre-feet per acre. In other words, it is only in unusual situations that irrigation engineers now think of the gross duty on well managed systems as exceeding about 3 acre-feet per acre, and then only for crops, such as alfalfa, that require heavy applications throughout a long growing season.

In methods of lessening conveyance losses of irrigation water practice likewise has advanced materially, mainly through the constantly increasing use of concrete and cement linings and, in the case of farm distribution, through the ever-growing use of underground pipe systems. Fifty per cent canal losses were taken for granted on some canal systems investigated by the Department of Agriculture in 1899, yet such waste would not be tolerated by the present generation. There are few canal systems of importance in the West on which at least the most porous sections have not been lined with either cement or concrete, whereas twenty years ago about the only examples of such practice were found on the two or three principal systems of southern California. Twenty years ago southern California was also practically the only irrigated section using pipe distribution systems on farms, whereas this method of carrying irrigation water is now not unusual in most parts of the West, and is the most usual method in many of our highly developed areas.

Take again the matter of methods of applying water to the land. In the earlier part of our period, for instance, few farmers gave attention to any other method of irrigating alfalfa than the so-called "mountain" method of flooding from contour ditches, or, in California, the contour or rectangular check. The "mountain" method is still employed on perhaps 40 per cent of our alfalfa farms, and the contour and rectangular checks still find favor with some because of particular local conditions. On the other hand, with lands at all suited to its use, the border method of applying water to the crop is chosen above all others because, if the "strips" are laid out properly, it is the most efficient method. Looking back to the year 1900, the only sections in the West in which the border method is known by the writer to have been in use are those about Woodland, California. Again, where shallow furrows and crude flooding were the most common ways of irrigating orchards in the earlier period, regardless of soil type and with little attention given to evenness of distribution and prevention of excessive waste by a too deep penetration, there are now farmers in every irrigated section in the West who understand that the type of soil and slope must govern both the method of irrigation to choose and just how that method is to be applied if thorough and even distribution of the irrigation water, without unreasonable and unnecessary waste, is to be accomplished.

Perhaps the greatest advance of all that we can record in the matter of the use of irrigation water is in the scientific point of view with which the subject is now being studied by both the investigators of our federal and state experiment stations and our better irrigators. For example, "What are the actual physiological requirements of the particular crop irrigated?", and "Of the water necessary to be applied to a given soil to give even penetration to the desired depth, how much will be held in the soil against gravity, how much is actually available to the plants, and how frequently is it necessary to re-apply water if a maximum product is to be obtained?" are typical questions we are now trying to answer. In other words, being fairly well informed on the physical means of spreading water economically over the soil, we now want to know the relation of soil moisture to the physiological functioning of the plants and to the physical functioning of the soil. It is in such terms that we are beginning to interpret the term "duty of water" as understood by the engineer charged with designing irrigation works or the public administrator of water rights charged with allocating water to users; and it is in similar terms that we are undertaking to think out the best irrigation practice for different crops growing on different soils.

Hydro-Electric Power a New Croesus for Irrigation

AS is well known, the past twenty years have witnessed the practical completion of important irrigation development in which direct flow of streams rather than storage has furnished the major portion of the water supply. Henceforth storage, and to a considerable extent very costly storage, must be the outstanding feature of new or enlarged irrigation enterprises. As every new need seems to create its own means of accomplishment, so a Croesus of nature has come forward to finance this new feature other than by charging it to the already overburdened backs of the farmers. We refer obviously to hydro-electric power which, as an incident to irrigation construction or vice versa, is opening the door to irrigation extension that without its aid would not be economically possible. In California, to cite only a single state, every one of the major new irrigation enterprises under organization has the development of a large power output as an essential feature. Witness only the Merced Irrigation District. There we find a projected outlay for irrigation of $12,000,000 bonds which have already been ungrudgingly voted by the people of the district, involving an acreage cost exceeding $60, if entirely charged to irrigation. But no such need exists; the irrigation district already has enter-

ed into a contract with the power company serving that territory, under which the return from power to be developed at the district's storage dam will carry the interest and sinking fund load on nine of the twelve million dollars the enterprise is to cost.

There is another project under organization in California by which hydro-electric will play an evén more essential part if the enterprise is to go forward; and we are all familiar with the overshadowing position hydro-electric power it to take in the proposed great Colorado River ventures.

Design of Irrigation Structures

WITHIN the past twenty-five years there has been an enormous change in the design of structures making up irrigation projects. We have not gone back to the time of the pioneers in irrigation because it would not be fair either to the past or the present to contrast the work of the two periods. The pioneer was working in an emergency and with the only materials at hand.

The modern structures of canal systems constructed prior to the organization of the U. S. Reclamation Service have been replaced by structures of reinforced concrete, but these less durable structures served their purpose in contributing to the education of the designing engineer. When the Reclamation Service entered the field its corps of engineers had two extremes from which to draw conclusions as to the most acceptable types of structures and materials of construction—massive construction following Egyptian and Indian practice and flimsy wooden construction of the then existing American practice. For obvious reasons they adopted a modification of the massive type. The standard set by them was the beginning of a policy of permanency in design, but economy was also made a major factor. The present standard of light reinforced concrete structures either cast in place or precast and assembled at designated points is the result of progressive steps and is also the result of splendid cooperation between members of the profession laboring for a common cause.

As an illustration, we may compare the La Grange dam built in 1894 with the Don Pedro built in 1922. In the former we have a structure 128 feet high built of Ashlar masonry, and for years after its completion it was considered one of the wonders of the engineering world. In certain respects (principally that of being an overpour dam) the La Grange dam is still an outstanding structure. On the same stream and not many miles above the dam the same agencies have just completed the Don Pedro dam, which is 283 feet high and built of concrete. The latter design permits of greater strength, more rapid construction, and lower costs.

Pumping for Irrigation

THE prominence attained by pumping for irrigation is perhaps most strikingly emphasized by reference to the last federal census figures, which show that nearly one-half (46 per cent) of the lands brought under irrigation during the ten years preceding 1920 are irrigated with pumped water. The capital invested for enterprises using pumped water had reached, in 1920, a total of nearly $140,000,000 or slightly more than the whole sum invested by the government in the works of the Reclamation Service. Even more impressive is the fact that the same total represented nearly 20 per cent of the cost of all irrigation works in operation in the census year.

While these comparisons take into account the many pumps irrigating rice in the fields of Louisiana, Texas, and Arkansas, they also include the similar plants in California, which is far in the lead of the other Western states in the number of its pumping plants and the extent of land irrigated by them. The raising of crops of marketable values justifying the expense of pumping even when lifts were high and the rapid extension of hydro-electric development, making accessible electric current for agricultural use at low rates, were leading influences encouraging this growth. At any rate, in 1920 California had three-fourths of all the pumping plants used for irrigation. Motors and engines of other types enumerated by the California census had combined capacity of slightly less than 400,000 horsepower; but so rapid was the continuing growth of pumping that in the spring of 1923, three years after the census date, a leading power company estimated that more than 500,000 horsepower was represented in electric motors in use in the state for agricultural service, practically all of which were concerned with pumping for irrigation.

While California and the Gulf States have led in the development of pumping for irrigation, the semi-arid belt, notably Western Kansas and parts of Nebraska and Northern Texas, has offered opportunities for irrigation by this means which are being taken advantage of more and more extensively. In Western Kansas, irrigation pumping plants have been developed to a point where they may be said to be standardized. A few years ago there were almost as many types of plants as there were plants in operation, with a very wide range in the cost of installation and as great a range in the cost of operation. To-day, in the valley lands of the state, there is but one type of plant being installed—an oil-engine-driven horizontal centrifugal pump on a battery of wells.

With this type of plant, contrary to popular opinion, the cost of developing a water supply is no higher than that of obtaining a supply from the gravity source. A pumping plant of this type large enough for the irrigation of 160 acres of land (having a capacity of between two and three cubic feet per second) can be put in at an average cost of $2000; in other words, the construction cost is about $12.50 per acre. This is very reasonable when compared to the cost of gravity systems in the west, very few of which can be developed at this time under $50 to $100 per acre.

It has been generally supposed that the cost of pumping is such as to limit pumping irrigation to intensively developed districts, but with present practice in Kansas, the cost is such that the water can profitably be used with any ordinary system of general farming.

The importance of pumping irrigation to this section is made apparent by an estimate by the state geologist of Kansas that there are more than five million acres of shallow water land in the valleys of the state. Irrigation is proving to be profitable, not only in the western third of the state, but almost anywhere in the eastern part where there is water available. Of course in the eastern part of the state where the rainfall is greater, the amount of water required is less, but the function of irrigation is to make up the deficiency in rainfall; in other words, to act as insurance against drought. Where droughts of from thirty to sixty days occur during July and August, as they frequently do in sections of the state, the importance of irrigation becomes almost as great in the production of a large crop as does irrigation farther west where it is needed to produce most of the crop.

In 1900, fuel oil, steam and electricity driven centrifugal and deep-well reciprocating pumps as well as air lift pumps were all in use for irrigation, generally throughout the West. The centrifugal pump was used for low heads to handle comparatively large quantities of water, while the reciprocating pump was used to raise water from greater depths but in smaller quantities. The motive power was poorly applied and often illy adapted to its task, and particularly in the case of the steam plants too expensive to be operated by the private individual.

Although Euler, the mathematician, published a discussion of the centrifugal pump in 1754, it was not until after 1900 that the pump had been developed to a point where its true abilities could be appreciated. It was capable of not over 70 per cent efficiency and could lift water little over twenty feet. The pump did not come into its own until the electric motor and steam turbine, both high speed rotative power units, became firmly established in their present degree of mechanical stability, after the start of the twentieth century. It is possible after these twenty years of improvement to design a centrifugal pump for almost any desired head, within reason, and for large installations to expect an efficiency up to 80 per cent at this head for a certain capacity. This was not the case before, when each manufacturer experimented with a little variation in blade shape from some other type, trying to

produce a better impeller. Now the pumps are understood, and design, not chance, is the ruling factor in production.

The deep-well turbine is a new development within this period. It is an application of the centrifugal pump in multiple on vertical shaft with the housing small enough to permit lowering inside of standard sizes of well casing. This pump handles a very much larger quantity of water than a reciprocating pump in the same casing could in the same time and does it very nearly as efficiently. It also eliminates the inertia forces of the reciprocating pump, which consumed so much of the power as the pump was lowered and the piston rod lengthened.

The air-lift pump has changed but little in the last two decades and its use in irrigation is limited to a few sections and to special conditions.

The fact that both the true centrifugal pump and the deep well turbine pump are high-speed machines has brought about the replacement of the steam engine and single-cylinder low-speed fuel-oil engine by the electric motor.

The electric motor has replaced these units for other reasons, such as the fact that it is clean, silent, requires little attention, is compact, light, and gives service ungrudgingly year after year. It, too, has been the subject of improving change so that the buyer is able to pick out the size, type, and speed that suits him best from any of several makes. It was characteristic of the first two or three years of the century that the motors were far too large for the pump and head so that an overburden of first cost was attached to the plants. The availability of electric current for operating pumps has enormously increased the installation of small plants; the average motor so used is of less than 25 horsepower.

Not the least of the change since 1900 is the introduction by the electric power companies of the sliding scale rate as compared with the flat charge per year per connected horsepower. This latter charge made a burden of the electric charge where the plant was run but at intervals, so that the power consumption was not large. The charge was about $50.00 per connected horsepower per year, and with the general tendency of applying a motor 100 per cent overcapacity to a given load, as was customary in 1900 and shortly thereafter, the power charge became exorbitant.

As there are still many places where electricity is not at hand, the fuel oil engine still maintains that field and the advancement that twenty years development has brought to these units has made them more efficient, lighter, and more stable in operation. The development of the small true Diesel engine during this period has been noteworthy, and probably will increase in use in the irrigation field where a combination of increasing lifts and the cost of electric power tends to make the expense of pumping prohibitive. While the steam engine has progressed in this period, it still remains a slow-speed unit. Its partner, the steam turbine, is not used to any degree in irrigation practice.

The inauguration of large irrigation projects with the corresponding demand for large quantities of water often producible by short lifts from streams has led to the introduction of the propeller-type pump, which has in the last decade become an important factor in the efficient elevation of these large quantities of water. This is an adaptation from the earlier forms of screw pump which had the blades set at intervals along the shafting which now has the blades assembled in one circle. Early forms of this pump were introduced for deep well use, having the blades at five foot ten inch intervals along the vertical shaft, but they met with the obstacle of lack of demand.

COMMITTEE ON IRRIGATION

Samuel Fortier, Chairman

A. G. Fellows	R. G. Hemphill
M. R. Lewis	G. E. P. Smith
G. E. Baker	F. L. Bixby
O. W. Israelson	W. L. Powers
H. E. Murdock	Andrew Weiss

(To be continued in an early issue)

Present Status of Electrical Machinery for Agricultural Purposes*

By C. N. Johnson

Mem. A. S. A. E. Engineer, Westinghouse Electric & Manufacturing Company

THERE have been published, at various times during the past few years, committee reports of societies interested in rural electrification and by manufacturing companies supplying equipment, both electrical and otherwise for rural work, various lists of machinery and operations on the farm for which electrical equipment was suitable and available in the market. The chairman of the Committee on Rural Power Lines suggested that this report be made a resume of various units of electrical equipment which are now available. We feel that a brief summary of the equipment available and suggestions as to possible future development from the machinery builder's standpoint would be more acceptable to the Society as a whole.

In the farmer's home, the use of electricity parallels its use in the city dwelling. The slightly increased cost in the rural home may limit its use to some extent, but here, as elsewhere, the convenience of this form of energy must be balanced against its cost. As a source of light which is efficient, safe and semi-portable, electricity has no equal. As a source of heat for small units such as electric irons, table stoves and the like, it is ideal. For all work around the house where a small power unit can be used to advantage, the small motor is a most efficient servant. For all these uses appliances are available both for electric circuits where power is supplied at 110-volt alternating current from power distribution lines or where current is obtained from a lighting plant operating at 32 volts direct current.

Around the dairy, barn and yard, the services of electricity is limited only by the amount of power available at any particular point. Practically all dairy equipment available is adapted for electric drive. For driving other small units around the farm, it is usually found advantageous to have a small portable motor unit which may be used for operating the different machines as occasion requires. The size of the equipment operated is limited only by the amount of power available as commercial motors may be obtained that are adapted to driving any size unit.

The question of furnishing special motor-driven equipment for any particular application is largely a question of cooperation between the builder of the particular machine and the manufacturer of electrical equipment. Manufacturers of electrical equipment are always pleased to do their share in assisting the development of equipment.

So far as the use of electric power for field work is concerned, very little has been done in this country towards a solution of the problem. As long as the power for operating the motor must be brought to it through the medium of wires, the motor-operated unit can be only semi-portable at the best. On small intensively cultivated farms, it is possible to adapt electric equipment for doing field work, but on larger fields this problem is still to be solved.

The supply of electric power to rural districts and its use there is at the present time largely an economic problem. So far as the use of electricity either for driving machinery or other purposes to which it is applicable is concerned, this presents no unusual difficulties. If we attack the various problems in such a manner as to analyze carefully the possibilities and apply the same general principles as have been used in solving the various problems of application to industrial work, we believe that this in time will show very definite and gratifying results. In any program looking toward constructive work in bettering the conditions of the rural section, the manufacturers of electrical equipment are always pleased to cooperate to the fullest extent.

* Part of the report of the A. S. A. E. Committee on Rural Power Lines.

The Relation of the Farm Equipment Industry to Agricultural Engineering*

By Raymond Olney

Mem. A. S. A. E. Secretary, American Society of Agricultural Engineers

WHAT applies to the Tractor and Thresher Department applies in like manner to all departments of the National Association of Farm Equipment Manufacturers. You have a very definite and important relation to agricultural engineering, whether with reference to the agricultural-engineering field in general or to the American Society of Agricultural Engineers in particular.

What is agricultural engineering anyway? There has been considerable misconception in the past as to what is comprehended in the term "agricultural engineering:" it is by no means restricted to that near engineering associated with manual training, elementary concrete work, knots and splices, babbitting, soldering, etc., etc. All this is best comprehended in the term mechanics and there is as much difference between farm mechanics and agricultural engineering as there is between digging a ditch and civil engineering.

Agricultural engineering is the application of engineering principles and practices to agriculture. That phase of agricultural engineering in which you gentlemen are most interested is what might be termed the "mechanics of production," especially as it relates to mechanical equipment. "Agricultural engineering" is a broad term; its scope includes a lot of things entirely outside of your field but with special reference to the farm-equipment business, everything pertaining to the design, construction, operation, efficiency, use, maintenance, standardization, research, economics, etc., of farm equipment is included within the scope of agricultural engineering.

Your designers and engineers are agricultural engineers. They are as much agricultural engineers as are any designated as such. Also they are agricultural engineers more than they are mechanical or automotive engineers, because their chief function is applying engineering to agricultural requirements.

The agricultural engineer has a two-fold job—first, to increase the efficiency and economy of farming operations, and, second, to raise the standard of living on the farm. This means a lot of things in the way of labor-saving equipment and methods, with which you are as familiar as I.

Unquestionably the biggest opportunity for increasing farming efficiency and economy lies in lowering production costs. Much is being said these days on this subject, but as yet very little has been done. Nearly a year ago in conversation with one of the officers of the American Farm Bureau Federation I said: "When you get your cooperative marketing and farm credit projects well under way, you still have what is unquestionably the biggist and most important problem of all to tackle, that of lowering farm production costs as the real source of profit to the farmer." He very emphatically replied: "You are absolutely right, but you would be surprised at the number of people who will say you are crazy if you mention such a thing."

I question if the agronomist or soil expert would agree with me, but I say without fear of having it disproved that the biggest factor in lowering production costs is the intelligent and adequate use of farm-operating equipment.

What is lowering production costs but the application of engineering to agriculture? It is primarily the job of America's agricultural engineers. That means the agricultural engineer over the drafting board; in your engineering, research, production, sales and advertising departments; the professional agricultural engineer; the agricultural engineer on the state college staff whether engaged in teaching, research or extension work, and last, but not least, the agricultural engineer in your dealer establishments. Incidentally, there is a big field of opportunity for you farm-equipment manufacturers in applying agricultural engineering to your sales and distribution problems.

In view of what I have said with respect to your relation to agricultural engineering in a general way, you naturally have an important relation to the American Society of Agricultural Engineers. If every farm-equipment manufacturer—and many of you did—had had one or more representatives at the annual meeting of our Society held at the Great Northern Hotel last week you would have been impressed with what that relation is, and you would also have been impressed with the necessity of making more effective use of that relationship.

There are two principal groups of membership in our Society—the college agricultural engineers and the engineers representing farm-equipment manufacturers. I don't need to point out to most of you the desirability, if not the necessity, of closer contact and a better understanding between these two groups. This relationship is already being promoted to a considerable extent. We have a number of committees doing some very constructive work, notably the Committee on Tractor Testing and Rating which has developed a tractor testing and rating code which we have every reason to believe will be adopted as standard by the tractor industry in the near future. The personnel of this committee, as is true of nearly all the committees in our Society, is made up of engineers from both the colleges and your organizations.

This contact between the two groups of engineers is essential to the best interests of both the maker and user of farm equipment. It gives the college engineer a broader viewpoint and familiarizes him with your designing, manufacturing, and selling problems. On the other hand, your engineers get the viewpoint—the engineering viewpoint if you please—of the farmers' problems and requirements, and they get it from the farmers' own "consulting engineer," the college agricultural engineer.

While we have some of your best engineers as members of the American Society of Agricultural Engineers, and active on committees and in other ways, from the standpoint of your interest there should be more of them. Agricultural-engineering development is anything but premature, or in advance of the need. The big problem in our Society is not to find work for our committees and individual members, but rather to decide the most important or most timely problems to attack and to find men capable of carrying them successfully through to conclusion.

You manufacturers miss one of the biggest opportunities you have when you don't see to it that your engineers are members of the American Society of Agricultural Engineers and taking part in its activities. You have a great many problems in your industry in connection with which the organization I represent can be of invaluable service to you. While not essentially an engineering problem, the question of the right kind of publicity is one that particularly concerns the farm-equipment industry at the present time, and in this connection I want to point out to you that we have an organization that can render you a real service along those lines. Newspaper publicity is all right

*An address before the annual meeting of the Tractor and Thresher Department of the National Association of Farm Equipment Manufacturers, Chicago, November, 1923.

so far as it goes, but the real need now is for basic information and practical ideas that will work—that is what the users and prospective users of your equipment want.

In other words, what this industry most needs is extension projects or investigations put on in the various states and dealing with a variety of important farm-equipment subjects, these projects to be under the direction of college agricultural engineers working in conjunction with your engineers or other representatives, and through the American Society of Agricultural Engineers as the central coordinating agency. These projects, to my mind, would in a short time begin to furnish material for the kind of publicity that means something—that has meat in it. The American Farm Bureau Federation would welcome with wide open arms any move of this kind and give it unqualified support. As an example of the attitude we might expect the Farm Bureau to take, let me direct your attention to the way it is cooperating with the electric light and power interests in an effort to direct electrical development and extension in agriculture along sound economic and engineering lines. You are all familiar with this project.

In this connection it was at the invitation of the Farm Bureau that the American Society of Agricultural Engineers was asked to have a representative on the Commitee on the Relation of Electricity to Agriculture, of which Dr. A. E. White is director, and Mr. Coverdale, secretary of the Farm Bureau, in an address at our meeting last week said, "It is the hope of the Committee on the Relation of Electricity to Agriculture that the American Society of Agricultural Engineers will become the outstanding leaders in the development of the rural electrical age."

The next subject I will touch upon is a delicate one—standardization. The whole farm-equipment industry is faced with a demand—yes, a growing demand—for standardization. You are having to meet it. The greatest fear of the farm organization leaders is that their members will force them to look into this standardization matter before they are ready. The leaders because of their closer contact with your problems appreciate that standardization takes time, where the rank and file of farmers do not. We have the situation of farmers being in too much of a hurry, and manufacturers perhaps not enough so.

Here is where the American Society of Agricultural Engineers is in a position to be of service; it gives makers and users a point of contact or neutral ground. In other words, it is an organization with the machinery set up for handling standardization problems, as well as other technical matters with which you are from time to time concerned. What better arrangement could be provided that would more nearly satisfy all interests than having the farmers' hired men—that is, the college agricultural engineers, who have the agricultural-engineering viewpoint and understand your language—working together with your engineers on A. S. A. E. committees on a standardization program?

The problem of standardization alone should emphasize the necessity of our Society having your unqualified moral support and of your seeing to it that your engineers are members and active in the work of solving the many problems that are put up to the agricultural engineer.

There is a very important reason for having a standardization program in your industry directed by the A. S. A. E. It will be easier to sell the results of such standardization work to the farmer, because his "hired men" have been looking out for his interests. I don't need to tell you that the farmer places a great deal of confidence in what the men on the agricultural-engineering staffs of the state colleges tell him. This confidence is growing. These men answer tens of thousands of mail inquiries from farmers in the course of a year and I want to say to you that their influence on the farmer is tremendous, and that influence is going to increase, because these "consulting engineers" of the farmer are capable, sincere men.

Have I made it clear to you why you should be interested and why your engineers should be active in our organization? I have put this up to you just as I would to a group of agricultural engineers whom I wanted to interest in becoming actively associated with our Society, because in a sense it is as much your orgaization as is the National Association of Farm Equipment Manufacturers.

Here is a piece of machinery all set up—a technical staff to serve your industry in common with the great industry of agriculture. The maximum effectiveness of this machine, however, is dependent upon some additional manpower. You have the man power we need. I urge your cooperation in promoting the cause in which we are all equally interested—that of making the business of farming more profitable and raising the standard of farm life. My main purpose has been to point out to you an opportunity where we could all put our shoulder to the same wheel in promoting a more rapid development of the engineering phases of agriculture.

A Big Reclamation Job for Agricultural Engineers

By Dr. Samuel Fortier

Hon. A. S. A. E. Associate Chief of Agricultural Engineering, Bureau of Public Roads, U. S. Department of Agriculture

THE field occupied by the American Society of Agricultural Engineers has now become nationwide and includes the principal engineering features of the agricultural industry. To my mind it was a wise thing to include in the activities of the Society the drainage of swamp and overflow lands and the irrigation of arid lands. After rather careful survey of the amount of water economically available throughout the western states, I have reached the conclusion that we can yet irrigate 30,000,000 acres of barren or low productive land. It may be possible to do even more than this since a considerable portion of the water now used in irrigation is wasted.

The extent of the wet lands requiring drainage only has also been estimated at 30,000,000 acres, and the extent of wet land requiring drainage and clearing is 50,000,000 acres, making a total of 110,000,000 acres that will some day be converted into profitable farms and rural homes.

I present these figures and the enormous amount of agricultural-engineering work which they involve, in order that the Society may continue to foster all activities along the lines of drainage and irrigation.

Research Methods in Agricultural Engineering

Research activities in the agricultural-engineering field are presented under this heading by the Research Committee. Articles dealing purely with the manipulation of research methods and equipment are featured. Members are invited to discuss material presented and offer suggestions on timely topics

The Place of Research in the Agricultural Engineering Field

By Earl S. Patch

Mem. A. S. A. E. Engineer, General Motors Research Corporation

Editor's Note: The following letter addressed to the Secretary by the chairman of the A. S. A. E. Research Committee, together with Mr. Patch's article, explains in considerable detail the plan and purpose of the new feature of the Journal to be conducted by the Research Committee. We want especially to emphasize Mr. Trullinger's request for the full cooperation of A. S. A. E. membership in making this effort most effective. The Research Committee is to be highly commended for this initial contribution; it is, to say the least, a masterpiece:

Mr. Raymond Olney, Secretary,
American Society of Agricultural Engineers,
Mt. Clemens, Michigan.

Dear Mr. Olney:

I am enclosing the manuscript of an article on "The Place of Research in Agricultural Engineering," by Mr. E. S. Patch of the General Motors Research Corporation, who is a member of the Research Committee of the American Society of Agricultural Engineers.

This article is submitted as the initial contribution from the Research Committee, and is intended to introduce its 1924 program as outlined to you verbally and by correspondence. It was deemed desirable by the Committee to open the program with a general introductory article, stating the committee's views and backing them up with some plain facts.

We are particularly fortunate in getting Mr. Patch to prepare this initial article, since he is connected with one of the large manufacturing organizations. In this connection it is quite gratifying to note that the opinions expressed by him in this article, which obviously reflect the viewpoint of a large private research institution, agree quite closely with the things which the Research Committee has been fighting for during the past three years.

It is believed that this article emanating from an authoritative commercial source should carry much more weight with the farm equipment manufacturing industry than if it emanated from a public institution. The article has received the careful and exhaustive scrutiny of the Research Committee, and it is believed that it will most effectively introduce our 1924 research activities. It is urged that it be printed in full not later than in the January issue of AGRICULTURAL ENGINEERING, in a designated research section.

The committee hopes to follow this initial article promptly with shorter and more specific articles, dealing purely with the manipulation of research methods and equipment in each succeeding issue of Agricultural Engineering. We are taking steps to get the College Section research committee into action, in order to broaden our sources of information and so that a study of research problems can be undertaken all over the United States, with a view to selecting timely problems for analysis and discussion.

It is hoped that the general membership of the Society will cooperate freely with the Research Committee and send the chairman suggestions as to problems regarding the research features of which specific advices is needed. It is only by such cooperation that the Research Committee can best serve the Society.

It is also believed that our program, if carried out effectively, should interest more of the prominent farm equipment manufacturers in the Society. We mean business and believe that our views if properly developed will go a long way toward helping the equipment industries to get on their feet.

I am leaving the naming of our research section in AGRICULTURAL ENGINEERING to you. I am much pleased with the "Survey of Agricultural Engineering Progress" which you have given the development or review section which I am conducting personally. The committee will be pleased to have you select just as snappy and descriptive a title for our research section.

Sincerely yours,
R. W. TRULLINGER

Chairman, Research Committee
American Society of Agricultural Engineers

THE tremendous advances made in the various sciences and industries during recent years are largely coincident with the development and practical use of research and research methods. "Research," properly practiced, is differentiated from its antecedent "experiment" in that it is characterized by a broader and more precise vision, a better and more orderly knowledge of fundamental units, a more complete, precise and accurate instrumentation, and a more thoroughly organized background. Experimentation may include one or more of these characteristics, but when all are comprised there is a logical development into research. Thus experimentation is merely an element of research.

By virtue of the distinguishing characteristics of research, its results are fundamental and are comparable with results secured by the same methods at other times, whereas the results of experiment are of value only in the case under consideration and at the time at which the work is done. Research determines the characteristics needed to accomplish a result or to reach a well-defined, practical objective, while experiment shows only the overall performance of a specific construction which may be merely an element of the ultimate objective. One is positive knowledge—the other immediate comparison, tinctured frequently with the faith and hope that so typify some inventors and designers.

Thus in dealing with the fundamental units of time, force, distance, and mass, the research method as applied to farm implement development, for instance, reduces results to permanently constant quantities. It substitutes for the vague "three-plow" claims of the designer the definite statement of "3,000 pounds drawbar load at 200 feet per minute," and changes the indefinite phrase " in any soil" to such a one as "in soil having a resistance of so many pounds per square inch when using a standard plow at so many feet per minute." It changes the moldboard designer's claim of lighter draft to a definite statement of gain obtained from lighter draft for a definite reason, and in addition, indicates specifically in just what part or function the gain has been made, thus making it possible to incorporate the same saving into the rest of the manufacturer's line.

Research to be real as well as profitable must be coordinated or organized. It must take fully into account all of the phases of collateral science that affect the result. It is necessary, therefore, to have specialists in the organization, each capable of coordinating his work with that of his fellows in the execution of the various projects under consideration. The rapidly increasing total of scientific and technical knowledge makes it impossible for any man to pose longer as a "vade mecum" of all science.

Thus by the application of research methods, an investigation of plow draft, for example, might involve a study of shearing and turning action by a physicist, a study of soil characteristics by a soils specialist, an investigation into the surface conditions of the moldboard by a metallurgist,

and an overall study by an engineer. Contrasted with the one man, part time method of so-called research so frequently employed at present, this may seem to be a monument of red tape. It is, however, exactly the form of red tape that has made possible the aeroplane, the steam turbine, and the electric generator.

The scientific instrumentation involved in research is of the utmost importance. To deal with fundamental units, we must first be able to measure them. From the days of Watt, who prided himself on the one-half-inch circular accuracy of his cylinder, to Johannson, who measures in terms of millionths of an inch, is not a long period of years, but the advance has been tremendous. But even more important is our increasing ability to measure accurately quantities that but a short time ago were all but unknown in their true sense and importance.

Thus in a tractor engine we may study such noises as piston slap by an instrument, which not only tells us the intensity of the sound, but its location with respect to the piston position as well. Knowing the volume and the position, we can easily make changes, always measuring the consequent results, and ultimately arrive at the laws which govern this annoying phase of motor operation.

Fuel knocks in engines were long known and accepted as an inherent defect. The General Motors Research Corporation and the U. S. Bureau of Standards thought otherwise, and by means of painstaking research uncovered the fundamental principles involved and demonstrated that it could be eliminated by easily made changes in the combustion characteristics of the fuel. Further research then resulted in the development of simple and economical means by which these fuel changes could be made. Incidentally, a new property of matter was discovered, and the result is now a commercial product. But no advance of moment could have been made in this direction without the development of special instruments to measure the quantities that affected the problem.

Another instance of the development of precise and accurate instrumentation occurred in the course of a fundamental study of the problem of the vibration occurring at definite speed ranges in a high grade automobile engine. It became apparent that this phenomenon was caused by torsional vibration of the crankshaft. It had not seemed possible to measure the deflections of such a shaft running at high speeds and, furthermore, it had not seemed particularly worth while to try. But research indicated that the deflection could be measured, that its phase with respect to the firing of the cylinders could be established, and that, with this information, a cure could be effected. These things were accomplished only through a painstaking fundamental study of the shaft and the forces acting upon it, and the development of instrumentation to measure the important quantities.

The field for the adoption of research methods in agricultural engineering is obviously just as extensive as in other lines. Practically no fundamental advances have been made in the design of farm implements for many years. The advent of the tractor has to a slight extent changed tillage implements, but obviously to nowhere near the extent possible. To satisfy the conditions of tractor operation, implements have been somewhat strengthened and in particular cases widths of cut have been increased considerably. But in the other dimensions and in characteristics, such as speed, but slight changes have been made. We turn metals today with high speed steel at speeds twice as great as we did with carbon steel tools. But the rate of plowing has not been increased even 100 per cent in the whole of the last century.

Some studies have been made showing increase of draft at higher speeds. But very little real effort has been made to determine the basic factors which affect this function and to design moldboards suitable for much higher speeds of operation under specific conditions. And at this point it may logically be asked if the moldboard plow is to be the ultimate tool for this important operation in land tillage. Turning to other farm machines, is there fundamental data to demonstrate, for instance, that the reciprocating cutter bar type of grass and grain cutting machine is to be the ultimate type?

A most significant study made at the University of Wisconsin has shown differences of almost 50 per cent in the power requirements and capacities of ensilage cutters. Undoubtedly experimental work of more or less magnitude has been done in the development of these machines. Each manufacturer has probably sincerely believed his machine to be really superior to all others on the market, yet, obviously, some of these machines are sadly lacking in some of the most fundamental characteristics. There is no assurance that an incorporation of all the good points of each machine into a single machine would give the optimum.

This lack of fundamental characteristics may be due to things other than mechanical design. Are our methods of cutting corn for ensilage basically correct? Is the pneumatic method the most economical and satisfactory for raising the ensilage into the silo? Can we definitely say that, excepting for little details and improvements of design, we have reached the ultimate in the art of preparing corn for insilage? It is believed that with the knowledge at present available these questions cannot be answered with any great degree of intelligence or finality. It is thus plainly evident that experimentation of the old order in farm implement development, limited mainly to a comparison of arbitrary changes with old standard construction, cannot possibly hope to develop the underlying truths of operation, but can only uncover the immediate effects of such changes.

The results of poorly organized experimentation may not only be of limited value but may be obtained only at an expenditure of considerable time and money. The results of such costly experimentation in the automotive industry, for instance, was brought out from some statistics which have been recently brought to the writer's attention. A large manufacturing organization maintains a special department devoted to the investigation of new devices submitted by inventors from all over the world. An effort is made to secure the fairest possible hearing for these new inventions. They are first examined by a competent engineer and are then passed upon by a committee made up of chemists, engineers, physicists, and business men. Every effort is made to secure the truth about these things, because the company actually desires to secure those things that will help it to make a better product. Yet, out of the thousands of inventions that are submitted yearly, less than 1 per cent are found to have merit enough to warrant even a thorough test.

Each of these inventions seems to its originator to have merit enough to warrant the expenditure frequently of hundreds of thousands of dollars in securing the patent and promoting interest in the device. And thus a vast total of money, time, and enthusiam is wasted because the fundamental factors and relationships which alone can make for success have not been studied. The tremendous scrap heaps in the back yards of many of our farm implement industries are just as eloquent monuments to the wastefulness attending poorly organized and costly experimentation which did not consider fundamental relationships and factors.

The adoption of research methods in fields of agricultural engineering other than that of implement development is equally important. It is becoming evident, for example, that drain tile should be proportioned in accordance with the laws of hydraulics and the little known principles of soil dynamics instead of by guess and the results of inadequate experiments. The economical design and erection of farm buildings suitable for their intended purpose instead of the perpetration of immature and frequently inadequate designs brought from other localities where conditions and requirements are entirely different is a logical outcome of the application of research methods to the farm structures problem.

In spite of the evident need therefor, the organization for research in the field of agricultural engineering is pitifully inadequate. Very few of the larger companies manufacturing farm implements, motors, and other equipment have what can be truthfully called research departments. Usually these organizations have little more than experimental departments functioning with the eyes of the pro-

duction and sales departments keenly upon them. Many of these organizations do not feel that it is necessary to incorporate the important characteristics of research procedure in their experimental departments in order to develop and improve their products. In this state of mind they can not hope to do real research, and the advancement of manufactured products on the basis of hit-or-miss experimentation has always been doubtful.

Some of the agricultural experiment stations are equipped to do a certain amount of this work, but, with a few exceptions, it is questionable whether the advances possible can be made to any very practical extent with the limited funds and personnel usually available. The attitude of most manufacturers of implements toward the work of public institutions is usually not very favorable. Frequently it is felt that about all that is necessary has been done when a sample piece of equipment has been turned over to a public institution for class use. Incidentally, the question arises as to how much of the time, energy, and limited facilities of public agencies should be devoted to the study and improvement of equipment, the manufacturers of which are too lethargic to strive to improve it themselves.

In the present state of the agricultural equipment industry, emerging slowly from several years of depression, many manufacturers feel, apparently, that the immediate problems of marketing and distribution are of more importance than the study of ways and means of so improving products that old designs will be unprofitable to handle. Obviously, the fallacy of this system is that it almost necessarily involves the perpetuation of old designs.

In this connection certain members of the equipment industry sometimes take pride in the repair orders that come in for machines built twenty-five years ago. The writer wonders if this is justified. A rather interesting deduction from this might be that evidently the improvements made have not been sufficient to warrant the user in discarding the old design for the new.

If the implement manufacturing industries believe in the permanent and logical improvement of their products, there seems little doubt that our present farm tools will look mechanically ridiculous to the engineer of a century hence. But this will evidently not be so if the implement industry makes no greater advances during that time than it has made during the past twenty-five years. It is believed in this connection that fundamental knowledge is needed in the implement industry now more than at any other time, in order that the usefulness of manufactured products may be increased to meet the steadily advancing requirements of the times. Those manufacturing organizations which actually have research departments are destined to be leaders in their industries. Those who think they have, but really have not, such research departments, may find themselves trailing along behind the leaders.

It seems unlikely that the expense of replacing obsolete tools with new equipment is prohibitive to the farmer generally. The big thing is the labor cost of the work done by the machine, and not the machine cost of doing an operation. If we could generally halve the labor cost of a crop by new equipment, the increase in machinery cost would hardly be noticeable.

Why can not this be done? If similar things have been accomplished in other industries, such as the electrical and automotive industries, through the medium of scientific research, it seems reasonable to believe that equally as striking advances can be made in the different branches of the farm equipment industry through use of the same medium.

To do this will require considerable careful thought and planning. Farm equipment industries must have faith in their engineering and research departments and must give them funds, personnel, equipment, and, most important of all, encouragement and opportunity to develop the different phases of the industry along specific fundamental lines.

There should be a closer relationship between the equipment industries and the agricultural colleges and experiment stations. The experiment stations should be encouraged to undertake more research with a view to establishing broad, general fundamental principles in agricultural engineering which may be used by the different farm equipment industries as foundations for development along specific lines. Such encouragement to the experiment stations should be given in the form of legislation and other measures to provide funds and personnel for the work, and experiment station officials should be made to recognize and appreciate the importance of fundamental research in the different branches of agricultural engineering, with special reference to the requirements of the farm on the one hand and the practical limitations of the equipment manufacturing industries on the other.

With these things at least partially in view, the American Society of Agricultural Engineers has had for several years a Research Committee, the purpose of which is to stimulate research in agricultural engineering in both public and private institutions, and to establish a closer cooperative relation between them. During the past, the activities of this committee have of necessity been confined mainly to reviewing and studying the results of research and experimental work carried on by the agricultural experiment stations and by such private institutions as publish their works, and of advising on the general planning and conduct of research work where specifically requested to do so. It has been found of considerable importance, however, that the Research Committee function most effectively in order that the Society may be able to hold its place with other national technical engineering societies. During the past two or three years, therefore, an effort has been made to broaden and strengthen the functions of the Research Committtee in order that it may serve the Society, not only as a repository of research data and as a means of effecting cooperation, but of giving both specific and general advice on the research phases of problems in agricultural engineering.

It is believed that what has been said above quite accurately reflects the general views of the present Research Committee. In line with those views and in execution of its advisory functions and its functions relating to the manipulation of research methods, the Research Committee for the present Society year proposes to analyze and discuss in each issue of AGRICULTURAL ENGINEERING the research features of one or more of the problems of the profession and where advisable to present suggested general programs of procedure toward their solution. It is proposed to consider problems of timely importance, especially those suggested to the committee by the membership of the Society. In addition, the committee proposes to study the field of agricultural engineering with a view to bringing to light problems of prime importance for discussion.

The discussion of these articles and suggestions by interested engineers and farm equipment manufacturers can be made of the greatest value to the Society membership as a whole. It is thus of obvious importance that all members suggest suitable timely subjects for discussion and when doing so make the freest possible disclosure of the fundamental facts developed in their own work. It is believed that through this medium a greater interest may be stimulated in research among the Society's membership and incidentally that the Society through its Research Committee may be enabled to render a broader and more effective service to its members, to the farm equipment manufacturing industries, and ultimately to the farmer himself.

The 1924 Annual Meeting

ATTENTION is again called to the fact that beginning 1924 the annual meeting of the American Society of Agricultural Engineers will hereafter be held during the latter part of June. The time and place for holding the meeting this year have not been decided upon, but will be definitely settled by the Council some time during this month.

Because of the large attendance of college workers at our annual meetings, it is proposed to hold the meetings just after the college year closes, probably the last week in June. The Council will be glad to have suggestions from members relative to the most convenient time.

Survey of Agricultural Engineering Progress

A review of current literature on engineering as applied to agriculture prepared monthly by Robert W. Trullinger, Mem. A. S. A. E., specialist in rural engineering, Office of Experiment Stations, U. S. Department of Agriculture

Kiln Drying Handbook, R. Thelen. [U. S. Department of Agriculture Bulletin 1136 (1923), pp. 64, pls. 12, figs. 12.] This bulletin presents in condensed and convenient form, the fundamental facts regarding the drying of wood for the special use of the dry-kiln operator. The major portion deals with the kiln drying of lumber, but specific suggestions are also included concerning the drying of other forms of wood. General information is said to be applicable to all kinds of drying. The data are for the most part based upon extensive investigations by the Forest Products Laboratory of the Forest Service.

Mechanical Tests of Some Mysore Timbers, J. H. C. Kann. [Journal Indian Institute of Science, Madras, 5 (1923), No. 14, pp. 209-228, figs. 2.] The results of transverse, tensile, shear, compression, and density tests of several samples of structural timbers from Mysore forests are presented and discussed.

Heat Transmission of Commercial Wall Board, G. A. Cumings. [Colorado Station Bulletin 282 (1923), pp. 8, figs. 5.] The results of an investigation to determine approximately the rates at which heat is transmitted through the leading makes of commercial wall boards are presented.

The average coefficient of heat transmission varied from 0.73 for beaver board to 1.01 for sheet rock wall board. Four other types of wall board had coefficients varying from 0.78 to 0.81.

It is stated that as an insulator of heat this material is a little inferior to common lath and plaster one-half inch thick. It is said to be superior to wood in many cases of light construction, since it is light and uniform and leaves no cracks. It is not as durable as lath and plaster. The experimental apparatus used is described and illustrated.

A Simple Beehive Incinerator, F. W. South and G. H. Corbett. [Agricultural Bulletin, Federated Malay States, 9 (1921), No. 4, pp. 263-270, pl. 1.] Drawings and general information on the construction and operation of a beehive incinerator for the destruction of refuse on farms and in villages are presented.

Farm Engines and How to Run Them, J. H. Stephenson. [Chicago, Frederick J. Drake & Company, 1923, pp. 255, figs. 75.] This is a simple practical handbook describing every part of an engine and boiler, with full directions for the safe and economical management of both. It includes also several hundred questions and answers often given in examinations for an engineer's license and chapters on farm-engine economy and water supply systems in the farm home. Numerous illustrations showing the different parts of a boiler and engine and a number of makes of traction engines.

The Principles Underlying the Movement of Bacillus Coli in Ground Water, With Resulting Pollution of Wells, C. W. Stiles and H. R. Crohurst. [Public Health Reports (U. S.), 38 (1923), No. 24, pp. 1350-1363.] A brief summary is given of the results of investigations conducted by the U. S. Public Health Service upon the movement of bacteria of fecal origin in ground water. Natural can material from can-type privies was used as pollution material, B. coli was taken as the bacterial test, and uranin dye was utilized in tracing the movement of water from dosing trenches to more than four hundred experimental wells.

The results indicate that pollution with fecal B. coli has up to date been followed definitely and progressively in ground water for distances of 3, 6, 10, 15, 25, 35, 45, 50, 55, 60, and 65 feet from the trench in which the pollution was placed, and uranin has been recovered from these same wells and has spread to other wells at distances of 70, 75, 80, 85, 90, 95, 100, 110, and 115 feet from the pollution trench. The soil in question is a fine sand with an effective size of 0.13 millimeter.

Pollution was found to travel these distances within a period of twenty-seven weeks and only in the direction of the flow of the ground water. It traveled only in a thin sheet at the surface of the zone of saturation. Even when heavy pollution was recovered at the top, water from lower levels was negative both for uranin and B. coli. As the ground water level fell, owing to dry weather, the pollution tended to remain in the sand above the new lower ground level, namely, in the new capillary fringe.

No evidence was obtained which would justify the conclusion that either the bacteria or the uranin is carried or moves to any appreciable distance in the capillary fringe itself, and there is said to be neither theoretical reason nor experimental evidence to justify the conclusion that either the bacteria or the uranin progressed in the dry, aerated intermediate belt between the capillary fringe and the upper soil belt. All present evidence is said to indicate that when the ground water level falls the pollution remains practically stranded in the capillary fringe or in the intermediate belt, according to the degree of fall of the ground water.

A rainfall of one inch resulted in a rise of from five to six inches in the ground water table in the particular experimental area used. If this rise were sufficient to reestablish the zone at the level of the stranded pollution, the bacteria and uranin were again picked up and carried along further in the direction of the ground water flow until dry weather again intervened to cause another fall of the ground water level. It is thus concluded that the progressive movement and the stranding of the pollution are intimately connected with, are dependent upon, and alternate with the rise and fall of the ground water level, and this latter factor is dependent upon the alternation of wet and dry weather.

In another series of experiments human feces were buried in pits in a locality of high ground water and covered with sawdust. Of five samples taken three years and two months after burial all were both macroscopically and microscopically recognizable as feces. Three of these samples were positive and two were negative for B. coli, and ova of Ascaris lumbricoides were recognizable in all five samples, but all found were dead. The practical bearing of these results upon the intermittent pollution of wells, the location of water supplies, and the justification of laws forbidding the use of abandoned wells for the disposal of excreta are considered self-evident.

Heat Transference and Combustion in Small Domestic Boiler, J. Blizard, W. M. Myler, Jr., J. K. Seabright, and C. P. Yagloglau. [Journal of American Society of Heating and Ventilating Engineers, New York, 29 (1923), No. 4, pp. 317-343, figs. 17.] The result of a series of tests made with various fuels with and without secondary air in an investigation of combustion and heat transference in a small domestic boiler are reported.

The trials so far carried out were divided into two series, namely, those in which the firepot and base only were used and those in which the firepot, base, and dome were used. The first series was run with no secondary air supply, the fire door being sealed tight. During one-half of the second series secondary air was admitted continuously through the slots in the fire door, and during the other half no secondary air was admitted. Each series of trials was carried out with anthracite, coke, bituminous coal, and natural gas as fuels.

The result of the first series showed conclusively that free oxygen finds its way from the ashpit to the stack, and, consequently, that with anthracite and coke the heat lost by not burning carbon monoxid was never over five per cent of the calorific value of the fuel. When burning bituminous coal, however, the losses caused by combustible gases, vapors and soot passing up the stack were fairly high. This is attributed mainly to the fact that since free oxygen is always present in the fine gasses, inadequate provision was made for igniting, mixing, and burning the combustibles rising from the fuel bed of the small furnace. One of the dominating factors militating against this is considered to be the low temperature prevailing above the fuel bed. It is considered obvious that the gases and air must be ignited by some hot exposed portion of the fuel bed or mixed with air which is preheated in some way, or that some means be taken to reduce partially the cooling action of the firepot if the combustible gases are to be burned.

In tests to determine whether admitting further air over the fuel bed would reduce the losses caused by the combustible gases, it was found that when burning coke and anthracite opening of the air ports gave an efficiency lower than when they were closed, but with bituminous coal the admission of secondary air raised the efficiency somewhat at the highest rating, although at the lowest rating the efficiency was lower when admitting secondary air. Firing the fuel by the cooling method did not raise the efficiency. These results are taken to indicate that after firing and particularly after stirring the fuel bed secondary air could probably be admitted to advantage.

The over-all thermal efficiency with the firepot alone as the heat absorbing surface varied between 51 and 59 per cent for anthracite and coke, between 33 and 40 per cent for bituminous coal, and between 40 and 57 per cent for natural gas. When the dome as added to the firepot and the ports in the fire door were kept closed, the efficiency varied between 57 and 60 per cent for anthracite and coke, between 41 and 48 per cent for bituminous coal, and between 55 and 63 per cent for gas. When secondary air was added the efficiency varied between 49 and 58 per cent for anthracite and coke and between 41 and 46 for bituminous coal. The lower efficiency of gas is attributed largely to the comparatively high loss caused by the total heat of the steam formed from the gas which left the boiler with the flue gases.

Activated Sludge Studies, 1920-1922, A. M. Bushell. [Illinois State Water Survey Bulletin, Urbana, 18 (1923). pp. 150, figs. 31.] This report describes the sewage experiment station of the Illinois Water Survey and the methods of conducting the activated sludge studies, and reports the results of recent work on the biochemistry

of the activated sludge process and on the microbiology and theory of activated sludge. The results of sludge drying experiments are also presented.

Tractors in Arkansas, D. G. Carter. [Arkansas Station Bulletin 168 (1923), pp. 3-18, figs. 7.] This bulletin summarizes the answers of one hundred tractor owners in Arkansas to a questionnaire relating to their tractor experience and the results of a certain amount of personal observation on the use of these tractors. In addition, a brief discussion is given on the use of tractors in the rice and fruit sections, together with an analysis of tractor failures. It is noted that the tractor sizes used ranged from 8-16 to above 15-30 in size. Both kerosene and gasoline were used as fuels.

A wide variation was noted in repair costs, amount of time used, number of acres plowed per day, and in other important factors. This is considered to emphasize the fact that the selection of a tractor that will be profitable is a special problem depending upon the size of farm, kind of crops, size of fields, and other factors.

Pit, Semi-Pit, and Bank Silos, L. W. Chase. [Nebraska Agricultural College Extension Circular 720 (1923), pp. 16, figs. 19.] Practical information on the construction of pit, semi-pit, and bank silos, with particular reference to Nebraska conditions is presented in this circular.

Effect of Repeated Loads on Concrete Slabs, R. B. Crepps. [Engineering and Contracting, Roads and Streets, Chicago, 60 (1923), No. 2, pp. 209-212, figs. 5.] Investigations of the fatigue element with respect to cement mortar, conducted by the Purdue University in cooperation with the U. S. Department of Agriculture, are reported. The original specimens were 30 inches long and 4 by 4 inches in crass section, and a 1:2 mixture was used.

The results of the 28-day tests with twelve beams indicated that no definite endurance limit between 40 and 60 per cent of that load required to break the beam under a single application can be assigned to cement mortar of this age. The results of the 4-month tests of eight beams indicated that the endurance limit is approximately 50 to 55 per cent of the static load. The 6-month tests with six beams showed that the endurance limit is from 54 to 55 per cent of the static breaking load.

The number of reversals of stress necessary to cause failure decreased in proportion to the respective increase of the percentage of stress above the apparent endurance limit. Stresses above the endurance limit caused continual progressive deformation. Stresses below the endurance limit may cause progressive deformation within certain limits. The effect of a rest period indicated that the rate and number of intermittent applications of load ranging in intensity above the endurance would have considerable bearing upon the life of a concrete structure. The amount of recovery in strength in the case of cement mortar was found to be directly proportional to the duration of the period of rest. Above the premature limit no appreciable recovery occurred.

Winter Tests Show Lower Mileage with Heavy Fuels, H. C. Dickinson and J. A. C. Warner. [Journal Society of Automotive Engineers, New York, 13 (1923), No. 1, pp. 87-92, figs. 3.] Fuel consumption studies conducted in connection with the above investigation, covering summer and winter conditions, are reported.

These showed that under winter conditions there is a small but definite increase in average fuel consumption of about 30 per cent, accompanying an increase of about 55 degrees in the 90 per cent point of distillation curve of the fuels. Taken by itself, this relatively small difference in consumption is considered to be unimportant compared with the estimated difference in the relative amounts of the two extreme grades of fuel obtainable from a given quantity of crude oil. Differences in starting and general performance corresponded with the relative volatilities of the fuel in the range of from 15 to 20 per cent of the distillation curve. The uninstructed drivers chose the fuels having the highest and the lowest distillation temperature in this range with remarkable consistency, notwithstanding the small existing differences.

The General Purpose Farm Tractor, C. M. Eason. [Journal Society of Automotive Engineers, New York, 12 (1923), No. 6, pp. 597-609, figs. 27.] The author divides the history of the application of mechanical power to farm work into three periods, reviews each, and comments upon the various phases of progressive development that influence the type of tractor most desirable for satisfying present needs. The requirements of farm work are outlined, and the different types of tractor built and being constructed to meet these demands are reviewed, including a discussion of large vs. small tractors, type of drive, power needed, control, methods of operation, and the factors constituting general-purpose service.

So far as adopting the tractor for farm usage is concerned, the author believes that the present limitation of such utilization lies with the tractor industry and with tractor engineers rather than with the farmer.

Insulated and Refrigerator Barges for the Carriage of Perishable Foods, A. Ewing et al. [(Great Britain) Department of Scientific and Industrial Research, Food Investigation Board, Special Report, London, 15 (1923), pp. III+21, figs. 3.] The results of an investigation of insulated and refrigerator barges for carrying perishable foods are presented.

It is concluded that a efficiently insulated barge not provided with refrigerating machinery is suitable for the conveyance of frozen cargo in cold weather, and that with an atmospheric temperature of 50 degrees Fahrenheit and sea water at 51 degrees frozen cargo, loaded at 20 degrees, with the chambers at 50 degrees, will carry with safety for forty-eight hours without precooling or other refrigeration. Further tests showed that with the same atmospheric and sea-water temperatures and with chambers precooled down to from 18 to 20 degrees, frozen cargoes can be carried with safety for ninety-six hours without any further refrigeration, provided all chambers are fully stowed. It was also found that with an atmospheric temperature of 76 degrees and sea water at 73 degrees, precooling is effective for forty hours only, where no refrigeration is utilized after loading.

Rear Axles for Trucks, E. Favray. [Journal Society of Automotive Engineers, New York, 13 (1923), No. 2, pp. 151-166, figs. 34.] The five types of final drive now in use on motor trucks are stated by the author to be chain and sprocket, bevel gear, worm gear, double reduction, and internal gear. The advantages and disatvantages of each type are enumerated. The bearing loads and shaft stresses of typical semi-floating and full-floating axles are calculated for maximum torque plus the normal radial load on the wheel, the wheel locked and skidding forward when the brakes are applied, and the wheel skidding sidewise while the truck is moving.

The results are taken to indicate that, while the maximum shaft stresses are practically the same in both designs, the shaft in the full-floating axle can be made lighter, and that a higher factor of safety should be employed in the semi-floating axle, since the bending stresses are continually reversed. As the bearing loads in the full-floating axle are considerably higher, a greater bending moment is imposed upon the axle housing, thus increasing the production cost of this axle.

Numerous photographs and drawings of various types of truck rear axles are included.

A New System of Electrical Cultivation, N. Forssblad (Vesteras, Sweden: Vastmanlands Allehandas Aktiebolags Tryckeri, 1923, pp. 14, figs. 4.) A system of cultivation by means of an electric tractor with attached plow and overhead electric cable winding on a drum is described and illustrated. The field is divided so as to reduce as far as possible the distance through which the plow has to be driven along the headlands while keeping the number of guiding ridges as few as possible. An open furrow is left midway between two ridges, and the headlands are plowed last of all.

During a short test the rubber insulated cable showed no signs of wear, which is taken to indicate that wear from contact with the ground is of small importance. During a long-time test a cable under stress was drawn over the pulleys at the mast and over a part of the cable drum, a distance equivalent to 4,600 miles, without being ruined.

House Insulation and Fuel Consumption, H. J. Burt (Concrete [Detroit], 23 (1923), No. 3, pp. 117 118). Data on the heat losses through walls and roofs of various types of materials are presented and discussed.

Heat Treating in a California Plant (American Machinist, 59 (1923), No. 19, pp. 679-681, figs 5). Information on the equipment used, its capacity, and the work done, and data on the steels and fuels used in the heat treating processes in a tractor plant are briefly presented.

The Economical Use of Irrigation Water Based on Tests, H. S. Clyde, W. Gardner, and O. W. Israelsen (Engineering News-Record, New York, 91 (1923), No. 14, pp. 548-552, figs. 6). In a contribution from the Utah Agricultural Experiment Station, a mathematical method of interpreting irrigation experiments and of determining the economical use of irrigation water under various conditions of water supply, irrigable land, cost of crop production, and value of crops produced is presented and discussed, based on the results of typical experiments in California, Idaho, and Utah. The method is applied where the water is available at a given price, where there is a large area to be irrigated and a limited water supply available, and where an area is partly dry farmed and partly irrigated.

It is shown that where water is available at a given price the economical number of acre-inches of water to be applied per acre to secure the maximum acre profit from the land is independent of the cost of plowing, seeding, fertilizing, etc., since the cost is not a function of the ratio of the cost of water per acre-inch to the price per ton of the crop on the farm. It is also shown that where a price is charged for the water, the maximum profit per acre will be obtained with some quantity of water less than the amount necessary to obtain the maximum yield.

Where a large area of land is available but the water supply is limited and it is desired to obtain the maximum profit for the entire area by use of the limited water supply, it is shown that the price of the water does not influence the amount of water for each acre which will bring the maximum profit for the entire area. However, if the most economical amount of water is used on each acre, then, as the cost of water increases the total profits decrease, and as the water cost decreases the total profits increase.

It was found that increasing the cost of ditching and application of the water on the farm is equivalent to increasing the cost of plowing, seeding, fertilizing, etc. and thus the economical number of acre-inches per acre is increased. This is taken to indicate that it will pay better to use more water per acre than to spread it over a large area, requiring more ditches and labor in application.

The analysis shows further that where an area is partly dry farmed and partly irrigated the situation differs from that of the second case only by an effective increase in the cost per acre of plowing, seeding, fertilizing, etc.

Denitrification as a Means of Sewage Purification, E. A. Cooper

(Biochemical Journal, London, 15 (1921), No. 4, pp. 513-515. In a contribution from the University of Birmingham, experiments to determine to what extent the purification of sewage can be effected through the utilization of nitrates by the reducing microorganisms present in the sewage are reported.

The results showed that the dissolved oxygen absorption figures for the mixtures of tank liquors and nitrate solutions or filter effluents were very much lower than those for the corresponding mixture of tank liquor and water only. These results are taken to indicate that incubation of the sewage with nitrate solutions and filter effluents leads to the destruction of a considerable amount of oxidizable material present in the sewage. With concentrations of nitrate amounting to about 5 in 100,000, the degree of purification was enormous, while with lower concentrations the purification was still appreciable. The extent of destruction of the oxidizable matter was not necessarily proportional to the amount of nitrate present.

A comparison of the dissolved oxygen absorbed in one, three, and five days showed that the one day tests indicated a higher degree of purification through denitrification than the three and five day tests. From this it was concluded that the very readily fermentable matter is first attacked in the process of denitrification, and that the more resistant oxidizable matter is largely left and its presence indicated in the prolonged dissolved oxygen tests.

The results as a whole are taken to indicate the value of employing the nitrates produced in sewage filters for further sewage purification. It is thought that in practice considerable economy could be introduced into sewage purification by mixing part of the sedimentation tank liquor with the filter effluent and thus employing the nitrate present for destruction of the more readily fermentable material. By this means a smaller filtering area would be sufficient to effect ample purifications.

The H-ion Concentration of a Creek, its Waterfall, Swamp, and Ponds, R. P. Cowles and A. M. Schwitalla (Ecology, Brooklyn, N. Y., 4 (1923), No. 4, pp. 402-416, figs. 3). Studies are reported which showed that the various sections of a creek situated on the campus of John Hopkins University showed decided differences in pH values. In ponds the pH was modified by the aquatic fauna and flora, although under certain conditions ponds maintained a practically constant pH. The pH of water flowing slowly over decaying vegetable matter was lowered, but when water flowed rapidly over a clean bed, most noticeably at falls and rapids, the pH was raised. This is considered to be a probable result of aeration.

The results are taken to indicate that in this creek the free carbondioxid content is apparently a determining factor in establishing and maintaining pH values. A marked tendency toward diurnal variation of the pH was observed in certain sections of the creek, this being readily brought into harmony with the variations in the free carbon dioxid content.

Comparative Gasoline Consumption on Different Road Surfaces, A. B. Cutter (Municipal and County Engineering, Indianapolis, 64 (1923), No. 5, pp. 193-195). Experiments to determine the gasoline consumption of automotive vehicles on Portland cement concrete, bituminous, and gravel or earth roads are briefly reported.

The distance of each test was 100 miles of continuous operation at a uniform speed of not less than 20 miles nor more than 30 miles per hour. There was practically no difference in the gasoline consumption of Portland cement concrete and the bituminous roads. The consumption was from 10 to 35 per cent greater on macadam roads in good condition than on either the concrete or bituminous roads.

The Application of Electricity to Agriculture and the Household, L. de Cartier d'Yve (Ministere de l'Agriculture, Belgium, Administration de l'Agriculture et de l'Horticulture, Avis aux Cultivateurs, No. 20 (1923), pp. 36, figs 28). General information on the application of electricity to household requirements and to small belt work on Belgian farms is presented.

The Use of Marl in Road Construction, C. H. Dow (Minnesota University, Engineering Experiment Station Bulletin 1 (1923), pp. VIII—67, figs. 71). The results of laboratory and field experiments on the use of marl in road construction in the State of Minnesota are reported.

The laboratory experiments showed that marl-sand is a weaker combination than clay-sand. On slaking, the marl-sand did not muddy or discolor the water, being practically insoluble. This is taken to indicate that less marl-sand surfacing will wash away in rainy weather than clay-sand. Marl-sand did not long remain suspended in water, and when dry it resisted the penetration of water for a long time. In comparison, clay-sand showed an immediate affinity for water. Marl-sand dried out nearly as slowly as clay-sand, and mixtures thereof were very compressible, retaining their molded shape under pressure,

The field studies of experimental roads, while not conclusive, showed that the marl-sand surface proved entirely satisfactory as a slab to bear up the weight of traffic, and also withstood heavy rains without noticeable injury. Beyond a certain amount of absorption, it seemed to be impervious to water. The application of a uniform coating over the width of the road with a very low crown seemed to be confirmed in principle. The mixture as used was homogeneous and yielded a smooth surface, without waves or chuck holes. After protracted dry weather and under heavy traffic, the surface became very dusty, the dust being somewhat more offensive than the ordinary kinds. Light traffic produced little or no dust even during protracted dry weather.

The results are taken to indicate that for light traffic the surfacing of a subgrade with marl-sand is satisfactory from every standpoint and is a great improvement over the loose sand through which it is built.

Benzol as a Motor Fuel, A. C. Fieldner and G. W. Jones (Chemical and Metallurgical Engineering, New York 29 (1923), No. 12, p. 543). Comparative engine tests with crude, acid-refined, and silica-gel-refined motor benzol, conducted at the Pittsburgh experiment station of the U. S. Bureau of Mines, are reported.

The results showed that crude motor benzol can not be used satisfactorily in an internal-combustion engine. Acid-refined or silica-gel-refined benzol developed no engine troubles and were satisfactory for use therein provided the refining process in either case was complete in removing the gum-forming constituents. Variation in air-fuel ratio in these tests showed no definite influence on the quantity of gummy deposits formed. It is stated that a motor benzol fuel which gives an evaporation residue less than 0.01 per cent by weight should not give gummy depositions in the intake manifold and on the intake valves when used in an internal-combustion engine.

Effect of Organic Decomposition Products from High Vegetable Content Soils Upon Concrete Drain Tile, G. R. B. Elliott (Journal Agricultural Research [U. S.], 24 (1923), No. 6, pp. 471-500, pls. 7). Studies conducted at the Minnesota Experiment Station on the influence of soils containing large amounts of organic matter upon concrete drain tile are reported. Experiments were conducted in the laboratory and in different marsh and bog soils in the state.

Preliminary laboratory studies showed that marginal and bog waters were alkaline in February and indicated that concrete tile were very alkaline even after being in the drain for five years. Old and new tile appeared to be similar except as regards density and thoroughly matured tile were soluble in weak organic acid. During a long period of curing concrete tile showed considerable absorption of carbon dioxid.

Further laboratory studies showed that partially decomposed tile had a tendency to set on grinding and moistening. The reaction of organic matter with concrete resulted in the production of gelatinous compounds which were soluble in carbonic acid. Organic compounds reacted with neat cement, and the quantity of acids in such organic compounds increased as decomposition proceeded.

The field studies showed that concrete tile as at present made break down in all peat soils in the presence of water no matter what the underlying mineral soil may be. A high percentage of lime or even the presence of marl is no guaranty of immunity. A high percentage of lime was found to delay but not to stop the process of disintegration. Acidity of the subsoil and porosity in the tile are factors hastening the process of disintegration.

It is concluded that if free alkalinity is an inseparable characteristic of concrete as at present made and if water is present, the ultimate destruction of concrete tile in the presence of organic acid seems inevitable since the free alkali and the free acid must react against each other.

Book Review

"Engineering on the Farm" by John T. Stewart, formerly professor of agricultural engineering, University of Minnesota, and edited by Eugene Davenport, formerly dean of the Illinois college of agriculture. has just been published. The book is written for the high school student of agriculture and is a practical discussion of problems which every progressive farmer must sooner or later meet. The book is divided into five parts—introductory, materials and construction, land improvement, building equipment, and mechanical equipment. The book contains chapters on records and reports, measurements, ropes, and the mechanics of materials, climatology, land surveys, wood, concrete, building materials, explosives, roads, irrigation, drainage, building construction, farm buildings, water supply, sanitation, house heating, lighting, lightning rods, telephone, principles of machines, motive power and gas engines. The book contains 533 pages and is published by Rand McNally & Company, Chicago. The price is $2.25.

"Farm Equipment for Mechanical Power." by Frank N. G. Kranich, Mem. A. S. A. E., according to the publishers announcement, "brings together in a single volume of convenient size a most complete collection of practical information on farm machinery—both drawbar and belt—for tractor use." In four hundred pages, thoroughly illustrated with photographs and drawings, Mr. Kranich tells exactly what type of machine can now be obtained for the various kinds of farm work and gives specific data on power required to operate them and how much work they will accomplish. The book is written for the farmer, implement dealer, manufacturer, and student. Draft machinery is covered in fourteen chapters dealing with plows, harrows, rollers, drills and seeders, mowers, haying machines, various kinds of harvesters, manure spreaders, wagons, and road machinery. Belt-driven machinery is covered in thirteen chapters including threshing machinery, silage cutters, shellers, huskers, saws, baling presses, pumps, as well as including testing belt speeds, lining up, and setting. Part III of the book includes such topics as engine cultivators, garden tractors, belts and belting, pulleys and pulley coverings, chains and sprocket wheels, lubricants and lubrication, tools and shop requirements, housing machinery and winter storage, and ordering repair parts. The author has been identified with the farm-machinery industry for eight years. He is a member and former president of the American Society of Agricultural Engineers, and is also a member of the Society of Automotive Engineers and of the Royal Architectural Society of England. Long experience in connection with all phases of farm equipment, as well as direct contact with manufacturers, has given Mr. Kranich a thorough first-hand knowledge of the practical side of his subject. The book contains 425 pages and 328 illustrations. It is published by the Macmillan Company, 64-66 Fifth Avenue, New York City.

AGRICULTURAL ENGINEERING

The Journal of the
American Society of Agricultural Engineers

The American Society of Agricultural Engineers is a voluntary, technical organization of engineers and others concerned with problems in engineering as applied to agriculture. The Society serves a distinct, specialized field in both engineering and agriculture; it is the central clearing house for agricultural-engineering information, the recognized coordinating center for promoting agricultural-engineering development, and the chief point of contact for agricultural engineers in their professional activities.

AGRICULTURAL ENGINEERING is the Society's journal for keeping members informed of the activities and accomplishments of the organization, its committees, and individual members—the medium of expression of progress in agricultural-engineering science; it is also the vehicle for broadcasting generally agricultural-engineering information. Contributions of interest and value to the agricultural field are solicited from both members and non-members of the Society for publication in this journal. Its columns are open for the discussion of all phases of agricultural engineering; the editor welcomes communications on timely subjects of interest or on which the attention of the agricultural-engineering profession should be focused.

RAYMOND OLNEY, M. E. A. E.
Editor

Whom to Recommend

"WHO will fill the position?" is a question constantly being asked in business, manufacturing, and professional circles. The employer, representing the individual or the group, is constantly on the lookout for talent that can be obtained when needed in the future. A position will some day open. This may be one or five years from now, but already possible candidates are being watched. This situation exists on every hand.

One very successful business man won his success largely by closely observing possible subordinates when he himself was in a minor executive position. When his advancement came, he was able to employ efficient men who contrubuted much to his later success.

Any man in an executive position owes it to himself to observe closely those whom he may wish to employ when the opportunity comes. He also finds it necessary to be able to recommend men for positions. The executive, of either big or little importance, who can recommend right men for the right place receives much desirable credit. It is one of the stepping stones to further advancement.

In the broad field of agricultural engineering, including, as it does, farm operating equipment, farm structures, reclamation and farm home conveniences, the best method of becoming familiar with the qualifications of others is through the A. S. A. E., especially at the meetings of the Society. Here the opportunity is offered of meeting men in the same profession from all points of the compass. It is possible to discuss mutual problems and mutual interests together. The monthly magazine of the Society, AGRICULTURAL ENGINEERING, also helps the man who reads understandingly to learn more of the qualifications of others.

The man specializing in any phase of agricultural engineering, in justice to his future welfare, should be greatly interested in the activities of this Society. He needs to know others and their qualifications.

F. A. WIRT

"How A. S. A. E. Has Helped Me"

IT has been suggested that a lot of ambition on the part of a professional man is to earn a competence and render a service to mankind.

To each of us is given an allotment of years which we all recognize is used by some more efficiently than by others. The efficiency of the individual in this connection depends in a large measure upon the assistance he secures from his fellows and the amount of enthusiasm he can develop for his work. It is in this connection that the professional society is of vital importance. Much can be accomplished by team work along professional lines that would be impossible by individual effort. Some men are helped more than others by enthusiasm, but the man is yet to be found who is entirely immune from the influence of his fellows.

In addition to the two foregoing benefits to be derived from A. S. A. E. membership, there is another equally important. It has been said that "friends are life's best asset, and to keep friends is life's greatest achievement." Membership in the Society and attendance at its annual meetings gives an opportunity for developing friends among kindred spirits, the value of which is inestimable.

J. B. DAVIDSON

ANY organization to be alive and a vital part of the world's affairs must have a different piece of work to do. This is true of A. S. A. E. as it offers a place for the exchange of ideas for men engaged in agricultural engineering, and sponsers agricultural-engineering projects. The organization cannot, however, be any stronger than its membership. It thus behooves every person engaged in agricultural engineering to join the American Society of Agricultural Engineers and to put their shoulder to the wheel.

The assistance that each member in an organization renders to make it a bigger and better one should not be given with the idea of receiving returns. However, the returns to those who work willingly in such endeavors are considerable, although this return cannot always be measured in dollars and cents. The business men of America have realized the truth of this as is shown by the readiness with which they have made the Rotary Club a success; the motto of this club is "He who serves best profits most."

The young men engaged in a profession need the assistance and contact that such an organization as A. S. A. E. offers. The old man in a profession needs this organization because he must keep up-to-date if he is to continue to be a factor in his profession.

The manner in which A. S. A. E. is functioning at present is very gratifying to those who have been with it long enough to understand the progress made, and there is no doubt that the future for the organization is very bright.

DAN SCOATES

IT is absolutely necessary for any organization or society to have some central point of contact in order to establish an exchange of ideas and to determine what is being done in various sections of the country. Our agricultural engineers have such an organization in the A. S. A. E., and I feel that it is the duty of every man engaged in that particular line to be associated with that organization in order to receive the greatest benefit from his profession. It is necessary for him to be in touch with this central organization so that he may know what developments take place and keep abreast of the most recent ideas.

I cannot state fully the great benefit that I have received from my A. S. A. E. membership. I remember very distinctly the first A. S. A. E. meeting I ever attended which was in St. Paul in the year 1911. At that time I was a student in the University of Nebraska, debating whether or not to go into agricultural engineering work. The contact with the men at this meeting caused me to see the great opening in the agricultural engineering field, and I felt that I could more readily be of service in that field than in other fields that I was contemplating entering. My contact with the membership since that time has been of great help to me in orienting myself with those in the field and in keeping in touch with recent developments. I feel that my first visit to the agricultural engineering convention, even though it was made under great handicaps, inasmuch as I was working my way through college, was one of the best investments I have ever made.

I feel that it is the duty of every member to enter into

the activities of the Society and render the best possible service that he can. It is a case where everyone should get in and work and boost. I feel that the activities of the Society offer a splendid opportunity for a man to become known in his field, which would be a distinct advantage, should he decide to change his location at any time.

O. W. SJOGREN

ONE thing that the American Society of Agricultural Engineers has given me that I could scarcely have obtained any other way, except at almost prohibitive expense, is an acquaintance with the leaders in the agricultural engineering profession. This has been of inestimable value in connection with my activities with the organization with which I am connected. It has made my work much more pleasant, as well as more effective.

W. G. KAISER

A. S. A. E. and Related Activities

A. S. A. E. Officers and Committees for 1924

Following is a list of officers and committees of the American Society of Agricultural Engineers for 1924. The list of committees is not complete, but as additions are made they will be published in the Journal.

OFFICERS AND COUNCIL

Samuel H. McCrory, President

L. J. Fletcher, First vice-president

E. R. Jones, Second vice-president

Raymond Olney, Secretary-Treasurer

F. W. Ives (Term expires June, 1926)

Wm. Aitkenhead (Term expires June, 1925)

G. W. Iverson (Term expires June, 1924)

E. W. Lehmann (Term expires June, 1925)

A. J. R. Curtis (Term expires June, 1924)

STANDING COMMITTEES

Nominating Committee—J. L. Strahan, Chairman; J. B. Kelly, I W. Dickerson.

Meetings Committee—E. A. White, Chairman; F. A. Wirt, John Swenehart, Daniels Scoates, F. W. Ives.

Committee on Publication—Raymond Olney, Chairman; R. U. Blasingame, K. J. T. Ekblaw, H. H. Barrows, C. W. Smith.

Finance Committee—William Aitkenhead, Chairman; William Boss, E. A. White.

Committee on Agricultural Engineering Research—R. W. Trullinger, Chairman; E. S. Patch, M. L. Nichols.

SPECIAL COMMITTEES

Committe on Agricultural Engineering Data—F. P. Hanson, Chairman; F. W. Ives, K. J. T. Ekblaw, F. J. Huse, W. A. Foster, E. A. Stewart, Wayne Dinsmore, C. O. Reed, J. B. Davidson, R. G. Hemphill, L. A. Jones, David Weeks, John Swenehart.

Committee on Agricultural Engineering Nomenclature—W. B. Jones, Chairman; G. B. Gunlogson, E. S. Patch, J. L. Strahan, M. C. Betts, John Swenehart, H. H. Barrows, C. E. Seitz, R. W. Trullinger.

Committee on Reforestation—H. H. Musselman, Chairman; T. F. Laist, L. P. Kieth.

Committee on Sesqui-Centennial (Philadelphia)—S. H. McCrory, Chairman; J. B. Davidson, R. U. Blasingame, O. B. Zimmerman, C. L. Allen.

Committee on Waste in Agriculture—F. A. Meckel, chairman.

FARM POWER AND MACHINERY SECTION

F. A. Wirt, Chairman

Committee on Power Farming—A. P. Yerkes, Chairman; C. D. Kinsman, Thomas D. Campbell, Max E. Cook, Samuel K. Dennis, Howard E. Everett, C. E. Frudden, George E. Fuller, A. H. Gilbert, George R. Holeton, N. I. Millikan.

Committee on Farm Transportation—R. A. Graham, Chairman.

Committee on the Manufacture of Farm Products—L. J. Fletcher, Chairman; E. W. Lehmann, R. W. Carpenter, J. C. Wooley, A. W. Christie, E. B. Doran.

Committee on Soil Dynamics—M. L. Nichols, Chairman; A. H. Hoffman, E. R. Jones, F. E. Steabner, L. W. Powers.

Committee on Tractor Testing and Rating—O. W. Sjogren, Chairman; G. W. Iverson, O. B. Zimmerman, H. H. Bates, D. P. Davies, F. N. G. Kranich, G. W. McCuen, W. J. Brandon.

Committee on Rural Power lines—C. A. Atherton, Chairman; I. W. Dickerson, A. R. Crawford, M. M. Jones, M. L. Nichols, E. A. Stewart, R. U. Blasingame, E. A. White, M. C. Betts, C. N. Johnson, G. C. Neff, W. H. McPheeters, E. E. Brackett.

Committee on Unit Farm Lighting Plants—L. S. Keilholtz, Chairman; C. A. Atherton, H. M. Beck, R. U. Blasingame, R. C. Cosgrove, J. B. Davidson, F. W. Ives, E. S. Patch, P. S. Rose, O. W. Sjogren.

Committee on Windmill Power—F. C. Fenton, Chairman; W. H. McPheeters, M. R. Bentley, H. M. Beck, Truman E. Hienton.

Committee on Belt Power Machinery—G. W. McCuen, Chairman; F. W. Duffee, I. P. Blauser, E. M. Mervine, Arthur Johnson, Albert F. Mohr, John Pugh, Jr.

Committee on Belting for Farm Machinery—John Mainland, Chairman; C. O. Streeter, A. B. Welty, William Warr.

Committee on Grain Handling Equipment—R. H. Black, Chairman; G. B. Gunlogson, W. J. Gilmore, H. B. Walker, E. A. Hardy.

Committee on Soy Bean Machinery—J. C. Wooley, Chairman; C. E. Seitz, E. R. Raney, W. C. Boney, A. H. Hoffman.

Committee on Motor Fuels—R. B. Goss, Chairman; C. S. Kegerreis, E. E. Brackett, Allen H. Head, W. C. Howell.

Committee on Stationary Farm Engines—E. B. Sawyer, Chairman; L. W. Chase, E. J. Baker, Jr.

Committee on Animal Motors—Wayne Dinsmore, Chairman; E. V. Collins, A. B. Caine, J. L. Edmonds, D. J. Kays, Guerney Gue.

Committee on Disk Harrow Investigation—E. V. Collins, Chairman.

FARM STRUCTURES SECTION

F. W. Ives, Chairman

Committee on Farm Building Design—W. A. Foster, Chairman; W. G. Kaiser, A. W. Clyde, H. R. Straight, L. P. Keith, H. M. Ward, C. S. Whitnah, E. A. Stewart, M. C. Betts.

Committee on Farm Building Equipment—D. G. Carter, Chairman; E. J. Stirniman, B. E. Gaylord, B. R. Mullen, J. Alden Werden, H. B. Emerson, Frank C. Harris, W. B. Clarkson.

Committee on Farm Building Ventilation—M. A. R. Kelley, Chairman; C. S. Whitnah, J. L. Strahan, C. W. Smith, W. G. Ward, J. B. Kelley, H. W. Riley.

Committee on Farm Sanitation—H. B. Walker, Chairman; R. W. Trullinger, R. C. Kelleher, J. R. Haswell, R. H. Driftmier, C. A. Norman, H. E. Murdock.

Committee on Farm Home Equipment—E. A. Stewart, Chairman; F. P. Hanson, Mrs. Mary A. Ives, P. B. Potter, Charles H. Hopkins, John F. McBane.

Committee on Farm Storage—K. J. T. Ekblaw, Chairman; B. R. Mullen, H. R. Straight, H. L. Belton, J. L. Strahan, W. G. Ward.

COLLEGE SECTION

Daniels Scoates, Chairman

Advisory Committee—Daniels Scoates, Chairman; J. B. Davidson, H. B. Walker, O. W. Sjogren, C. O. Reed.

Commitee on Cooperative Relations—H. B. Walker, Chairman; J. B. Davidson, O. W. Sjogren, P. B. Potter, L. J. Fletcher.

Committee on Research of the College Section—R. W. Trullinger, Chairman; D. Scoates, R. H. Driftmier, W. J. Gilmore, W. H. McPheeters, W. T. Ackerman, H. B. White, D. G. Carter, F. W. Knipe.

Committee on Advancement of Agricultural Engineering Education—F. W. Ives, Chairman; C. W. Smith, C. O. Reed, E. J. Stirniman, W. T. Ackerman.

Committee on Aims and Objectives of the Agricultural Engineering Curriculum—J. B. Davidson, Chairman; H. B. Walker, O. W. Sjogren, J. C. Wooley, F. W. Ives, L. J. Fletcher, D. Scoates.

Committee on Teaching Methods—C. O. Reed, Chairman; F. R. Jones, Lew Wallace, H. W. Riley, L. J. Fletcher.

Committee on the Standardization of Courses—C. W. Smith, Chairman; W. J. Gilmore, E. R. Jones, W. A. Foster, M. M. Jones.

Committee on Agricultural Engineering Extension—H. H. Sunderlin, Chairman; Mark Havenhill, T. E. Hienton, R. L. Patty, E. R. Gross, M. R. Bentley, I. D. Wood.

Committee on the Standardization of Blue Print Service—F. W. Ives, Chairman; R. L. Patty, H. H. Sunderlin.

Committee on Student Branches—J. B. Davidson, Chairman; F. W. Ives, Daniels Scoates, E. W. Lehmann, C. E. Seitz, E. R. Jones, H. B. Walker, W. C. Howell, J. C. Wooley, O. W. Sjogren.

RECLAMATION SECTION

John Swenehart, Chairman

Committee on Drainage—J. R. Haswell, Chairman; L. A. Jones, C. E. Ramser, W. P. Miller, H. B. Roe, E. V. Willard.

Committee on Land Clearing—L. F. Livingston, Chairman.

Committee on Land Settlement—Wallace Ashby, Chairman.

(Continued on page 24.)

Conference on Lumber Standards

THE following report of the A. S. A. E. representative at the conference on lumber standards in Washington last month, Morris C. Betts, of the U. S. D. A. division of agricultural engineering, will be of interest to members of the Society:

"I attended the conference called December 12 by the Secretary of Commerce to take action on the standards recommended by the Central Committee on Lumber Standards. The conference, at which were represented various interested organizations other than those intimately identified with the lumber trade, adopted the recommendations submitted with very few changes, most of the discussion being on the question of the thickness of the standard board. The official statement of the proceedings giving the complete standards as adopted will be available in the near future.

"The standards adopted have to do only with standard lumber classifications, standard grade names and classifications, standard yard lumber sizes, method of lumber measurement, standard shipping weights and shipping provisions. There are other matters to be given consideration by the Central Committee, which is to report at a conference to be held about April 15.

"Mr. Hoover expressed the opinion that the adoption of the standards, as finally agreed upon, was a very pronounced step in the right direction and will serve as a basis for further standardization in the lumber trade."

Progress of Bolt, Nut, and Rivet Standardization

THE American Engineering Standards Committee recently approved the personnel of the committee which is developing standards for bolt, nut, and rivet proportions under the sponsorship of the Society of Automotive Engineers and the American Society of Mechanical Engineers. The working committee of forty-three members is dealing with the following specific subjects: Large and small rivets, wrench head bolts and nuts, slotted head products, track bolts and nuts, carriage bolts, special bolts and nuts for agricultural machinery, body dimensions and material, and nomenclature. This project originated in the proposal to standardize the widths across flats on nuts and bolt heads, in order to reduce the number of wrenches required to handle the numerous bolts and nuts on machinery and tools.

The American Society of Agricultural Engineers is represented in the organization of the working committee, which includes twenty trade and technical societies and groups.

Personals

F. W. Duffee and **G. W. Palmer** are joint authors of a new bulletin "Turn on the Light," being Circular 163 just issued by the extension service of the College of Agriculture, University of Wisconsin, a very complete treatise on the application of electricity to farm requirements in the form of light, heat, and power. The acetylene and hollow-wire gasoline systems of lighting are treated briefly.

M. A. R. Kelley, Agricultural Engineer, Bureau of Public Roads, U. S. Department of Agriculture, is joint author with E. W. Sheets, Senior Animal Husbandman, Bureau of Animal Industry, U. S. Department of Agriculture, of a bulletin entitled, "Beef Cattle Barns" just issued as Farmers Bulletin No. 1350 by the U. S. D. A.

Finley P. Mount, president, Advance-Rumely Company, announces the purchase by his company of the entire business, assets and good will of The Aultman and Taylor Machinery Company, of Mansfield, Ohio. The sale and distribution of the Aultman and Taylor line of machinery and repairs will be continued through the branch houses of the Advance-Rumely Thresher Company.

C. O. Reed, of the department of agricultural engineering at the Ohio State University, will have charge of a thorough farm implement survey of the State of Ohio to be conducted by the department of agricultural engineering at O. S. U. in cooperation with the U. S. Department of Agriculture. The purpose of the survey is to obtain an accurate and complete picture of the machinery and labor situation on Ohio farms. This will be the first survey of its kind in a single state, and if it produces the information expected it is likely that similar surveys will be made in other states in cooperation with the U. S. D. A.

John Swenehart, assistant professor of agricultural engineering in charge of land clearing at the University of Wisconsin, and **W. A. Rowlands,** assistant in land clearing at the same institution, are joint authors of Circular No. 164, entitled "Blasting," just issued by the agricultural extension service of the University of Wisconsin. It is a very complete and comprehensive treatise on the use of explosives in land clearing, and is fully illustrated. The authors are to be congratulated on this most creditable piece of work.

New Members of the Society

L. B. Bassett, associate professor of farm management, University of Minnesota, St. Paul, Minnesota.

Alfred Arnold Clough, field engineer on farm construction with Portland Cement Association, 97 Taylor Street, Wollaston, Massachusetts.

Henry Giese, department of agricultural engineering, Iowa State College, Ames, Iowa.

Alexander Gordon, assistant in rural engineering, College of Agriculture, University of the Philippines, Laguna, Philippines.

Norman Stuart Grubbs, agricultural engineer, Portland Cement Association, 120 Price Street, West Chester, Pennsylvania.

Charles Ernest Ramser, research work in drainage and flood control, Bureau of Public Roads, U. S. Department of Agriculture, Washington, D. C.

Archie A. Stone, head of department of farm mechanics, State Institute of Applied Agriculture, Farmingdale, New York.

Arthur Leighton Young, instructor in farm mechanics, University of Illinois, Urbana, Illinois.

TRANSFER OF GRADE

Truman E. Hienton, department of agricultural engineering, Iowa State College, Ames, Iowa. (From Junior to Associate Member.)

J. Ramos Martinez, manager Mexican division of Foreign Trade Department, Sweet & Phelps, Inc., of Chicago, Illinois, Apartado Postal No. 736, Mexico, D. F., Mexico.

Applicants for Membership

The following is a list of applicants for membership received since the publication of the December issue of AGRICULTURAL ENGINEERING. Members of the Society are urged to send pertinent information relative to applicants for the consideration of the Council prior to election.

A. B. Carfer, fieldman, promotion and extension of use of concrete on farm, Portland Cement Association, c-o Y. M. C. A., Parkersburg, West Virginia.

Carl A. Tefft, farm manager, Avoca, Nebraska. (Transfer from student branch member to Junior member.)

A. S. A. E. Employment Service

This service, conducted by the American Society of Agricultural Engineers, appears regularly in each issue of Agricultural Engineering. Members of the Society in good standing will be listed in the published notices of the "Men Available" section. Nonmembers as well as members, are privileged to use the "Positions Available" section. Copy for notices should be in the Secretary's hands by the 20th of the month preceding date of issue. The form of notice should be such that the initial words indicate the classification. No charge will be made for this service.

MEN AVAILABLE

MECHANICAL AND ELECTRICAL ENGINEER, graduate of Cornell University and Armour Institute, with nineteen years of practical experience in designing, manufacturing, and marketing gasoline engines, automobiles, motor trucks, and tractors, having specialized particularly on internal-combustion motors and their application, prefers mechanical work cooperating with the different manufacturing and sales departments along the lines of sales engineering, or other work into which his qualifications would fit. MA-104